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FORTHCOMING MEETINGS

MONDAY, 30TH APRIL, at 6 p.m. The last of three CANTOR LECTURES on '*Modern Welding*', by H. G. Taylor, D.Sc., M.I.E.E., F.Inst.P., Director, British Welding Research Association. (The syllabus for these lectures was published in the *Journal* for 30th March.)

WEDNESDAY, 2ND MAY, at 2.30 p.m. '*Beauty in Danger—the Urban Scene*', by Sir Hugh Casson, M.A., F.R.I.B.A., R.D.I., Professor of Interior Design, Royal College of Art. The Right Honble. The Earl of Euston, M.A., F.S.A., Deputy Chairman, Society for the Protection of Ancient Buildings, and Member, Historic Buildings Council for England, will preside.

MONDAY, 7TH MAY, at 6 p.m. The first of three CANTOR LECTURES on '*Some Recent Studies of Sociology*', entitled '*Class Conflict and Social Mobility*', by T. S. Simey, M.A., Charles Booth Professor of Social Science, University of Liverpool.

WEDNESDAY, 9TH MAY, at 2.30 p.m. '*Automation*', by the Right Honble. The Earl of Halsbury, F.R.I.C., F.Inst.P., Managing Director, National Research Development Corporation, a Member of Council of the Society. The Right Honble. Lord Latham, J.P., F.A.C.C.A., F.C.I.S., a Member of Council of the Society, will preside.

MONDAY, 14TH MAY, at 6 p.m. The second of three CANTOR LECTURES on '*Some Recent Studies of Sociology*', entitled '*Some Aspects of the Development of Demography*', by David V. Glass, B.Sc.(Econ.), Ph.D., Professor of Sociology, University of London at the London School of Economics.

WEDNESDAY, 16TH MAY, at 2.30 p.m. PETER LE NEVE FOSTER LECTURE. '*Electronic Photography*', by C. G. Mayer, O.B.E., M.I.E.E., of the Radio Corporation of America. Sir Harold Bishop, C.B.E., F.C.G.I., M.I.E.E., M.I.Mech.E., Director of Technical Services, British Broadcasting Corporation, will preside.

Fellows are entitled to attend any of the Society's meetings without tickets (except where otherwise stated), and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

FACULTY OF ROYAL DESIGNERS FOR INDUSTRY

The Faculty of Royal Designers for Industry held a luncheon at Kettner's Restaurant on Wednesday, 11th April, in honour of Sir William Lyons, R.D.I., who received his Knighthood in the New Year Honours, and Mr. Walter Gropius, Hon.R.D.I., who was paying a brief visit to England to receive the Gold Medal of the Royal Institute of British Architects, and who had not previously had an opportunity of attending a Faculty function. He was appointed an Honorary Royal Designer for Industry in 1947.

After luncheon there was a most interesting informal discussion based on the following brief address which was made by Mr. Gropius:

It is a great honour and pleasure for me to come finally face to face with a group of people who already years ago acknowledged my concern with the improvement of industrial design by taking me into their circle.

Since my architect colleagues have now also established my name in their ranks I feel more than ever that in England, ever since the days of Ruskin and Morris, a strong sympathy exists for all those who feel responsible for the development of the incubus we have let loose on an unsuspecting world: the machine.

I have only recently returned from a world-wide tour which took me to the South American, Australian and Asian continents, and if anything could have convinced me more strongly that our Western world will have to find better answers to the problems of an industrialized society it was seeing the impact of our civilization on cultures remote and alien to our ambitions, our goals. In spite of some material, hygienic and even social gains, the disadvantages of the sudden conversion were far more in evidence than the advantages, and when a customs official in Japan asked me seriously upon my entry into that country: 'Are you engaged in culture?' I felt a sudden pang of conscience about our ability to export this precious commodity to peoples who still live so much closer to the remnants of an integrated way of life and its visual manifestations than we do.

As for the work I myself have done in trying to relate and reconcile the diverging and contradictory tendencies of our time, I might feel satisfied to see my own brain child, the Bauhaus-idea, become so strong and independent, writing its own history in many languages now.

But it worries me that all too often only one section of its complex structure has been singled out for inspection, implementation, discussion and study, when all that *really* mattered was to see the *whole* of it, to comprehend the points of connection, of relation, of integration.

I remember one sad experience in this respect which I had after the death of my friend Moholy-Nagy. I tried at that time to persuade museum and art circles to put on an exhibition of his work as a painter, a photographer, a designer, and as an educator, to show how ardently he had tried to demonstrate the necessity for integration of all those fields in his own life. Well, I got nowhere with this idea. One group was ready to show his paintings, one group wanted to exhibit his design work and another concentrated on his ideas as an educator. I found absolutely no understanding for the essential point I had wanted to make, because the different factions are still all tied strictly to their limited objectives and do not see these sufficiently as parts of a unified entity.

From this point of view Japan was a revelation to me. There, for three centuries, certain standards for building and everyday goods remained unchallenged, but they reached such a broadness of conception that infinite individual interpretations within the same standard framework were produced: there was unity in diversity, which, after all, is also our final goal for the industrialized society.

I know that the members of your group have made many creative efforts in this direction and I am very proud to belong to you.

THE BENJAMIN FRANKLIN MEDAL

Some months ago Lord Halsbury suggested to the Council that as the Albert Medal, the Society's senior award, is normally given to men who have already attained wide repute and received high distinctions and who usually, moreover, are already advanced in years, there was room for an additional award for younger men who have already made a name for themselves, although in possibly a more limited circle, and have thereby given promise that they may well have a career of further distinction ahead of them towards which a high award from the Royal Society of Arts would be a real encouragement.

This proposal has been under careful consideration by the Council and the Special Activities Committee and at the meeting of Council on 9th April the following Resolution, which has since received the approval of His Royal Highness the President, was adopted:

1. In the 200th year after the election of Benjamin Franklin to membership of the Society for the Encouragement of Arts, Manufactures and Commerce, and in pursuance of the Society's titular objects, the Council resolve to institute a new award, to be known as 'The Benjamin Franklin Medal', which shall be made annually (subject as is hereinafter provided), in the month of January, to individuals who have attained early distinction, with promise of further achievement, in the promotion of arts, manufactures and commerce.

2. Each year the Council shall at its July meeting appoint a selection committee of five members, representative jointly of arts, manufactures and commerce, which shall submit to the Council at its October meeting a name or short list of names deemed suitable for consideration for the award, with appropriate comments for the information and guidance of the Council. The Council shall then at its November meeting decide upon a name for submission to the President for his approval and the award shall formally be made by the Council at its January meeting, always provided that they may withhold the award if in their, or the President's opinion, no suitable name has been proposed. It shall be in the power of both the President and the Council to suggest any name to the committee, but no award shall be made unless the name of the proposed recipient shall have been duly considered by the committee.

3. The Council, in instituting the medal, propose, but not as a binding procedure, that the Selection Committee in drawing up their recommendations, may find it desirable to consider different specific spheres of activity by annual rotation.

PROGRAMME FOR THE 203RD SESSION

The Council will shortly be considering the programme of meetings for the forthcoming Session, and Fellows are invited to forward to the Secretary suggestions for lectures and papers by 1st June.

INSECT PHYSIOLOGY IN RELATION TO INSECTICIDES

The Fernhurst Lecture by

V. B. WIGGLESWORTH, C.B.E., M.D., F.R.S.,

Quick Professor of Biology in the University of Cambridge, Director of the Agricultural Research Council Unit of Insect Physiology, delivered to the Society on Wednesday, 25th January, 1956, with E. Holmes, M.Sc., Ph.D., Technical Director, Plant Protection Ltd., in the Chair

THE CHAIRMAN: I am honoured and pleased to have been asked to take the chair to-day, partly because I have a great regard and respect for the work of Professor Wigglesworth and his colleagues at Cambridge, but also because our relative positions here are indicative of the happy relations which now exist between technical men doing fundamental research at the Universities and those doing applied research in industry. It was not always so!

There is, of course, precedent for such an arrangement. As recently as 23rd November last, Dr. R. Holroyd, Research Director of I.C.I., took the chair here at the Royal Society of Arts for a paper on 'Research in Industry', by Dr. B. K. Blount of the Department of Scientific and Industrial Research. I gather that on that occasion there was some considerable discussion on nomenclature, and whether or not fundamental research should properly only be done in the Universities, leaving applied research only to industry and the trade associations. Dr. Holroyd went so far as to say that we in the crop protection industry must do some fundamental research ourselves. However, this particular question need not concern us unduly this afternoon since there is obviously ample work to keep us all busy.

Some of the same arguments were aired at a meeting of the Farmers' Club, on 7th of November last, when Lord Rothschild gave a stimulating paper on 'Research in Agriculture'. I mention that because Lord Rothschild is, I suppose, Professor Wigglesworth's chief so far as the A.R.C. Unit of Insect Physiology at Cambridge is concerned, and because he was talking, in part, about the translation of research results into techniques useful in agriculture—another highly controversial subject.

The following lecture was then delivered:

THE LECTURE

When the late Dr. W. W. C. Topley was appointed Secretary to the Agricultural Research Council, one of his early decisions was to convene a conference on insecticides and agriculture, the terms of reference of which were to take evidence and to make recommendations on the steps needed for the development of research in that general field. As the evidence accumulated it became apparent that the scientific study of insecticides was being impeded by our lack of knowledge of insect physiology. Among the proposals put forward in the course of the discussion was one that the Council should establish a Research Unit for the physiological study of insecticidal action; and I was invited to take charge of such a unit.

I am afraid my reply was to the effect that I was not interested. For it seemed to me that that would form too narrow a foundation on which to base the

contribution of insect physiology to agriculture. Topley's reaction was typical. He asked me to set out my idea of the sort of Unit of Insect Physiology that was required—and he then virtually returned my letter in the form of an offer of appointment.

Early in 1945 I had the opportunity to visit the United States and there I found that the same process had been going on. During the earlier war years all the obvious practical trials and experiments with existing materials seemed to have been made, and there was a strong feeling in the air that what was needed most was a better understanding of insect physiology. This has resulted, in the post-war years, in a number of appointments and a great many research grants. But I discovered in Washington that almost everyone who spoke of insect physiology was really thinking of insect toxicology. Now I am fully convinced that insect physiology has a real contribution to make to the killing of insects by means of chemicals. But insect physiology is not an applied science—it is a fundamental science; and what is holding matters up is not our failure to know just how γ-BHC kills the insect, but our lack of knowledge of the internal working of the insect as a whole.

INSECT RESPIRATION

I like to quote the example of Aristotle. It had long been known to the shepherds of Macedonia that to smear the inner surface of the garments with oil was an effective measure against body lice. Aristotle studied the matter experimentally and showed that insects are always killed if oil or butter is applied to the surface of their bodies. The reason for this was quite obscure. It was made clear by the discovery of Malpighi, about two thousand years later, that insects breathe by means of branching tracheal tubes which convey air directly to the tissues. Then, rather more than a century ago, Burmeister described the sphincters which keep the tracheal spiracles closed; and within our own time we have come to realize that this is all part of the machinery necessary to permit the insect to take in oxygen and yet to keep its loss of water by transpiration down to the minimum—and that it is the efficiency of this machinery which has made the insects such successful competitors with man for the domination of the dry land.

None of these discoveries is of immediate importance in the control of insect pests. But anyone who is thinking scientifically about killing insects takes all this knowledge for granted as part of the data of his problem. It was this method of respiration which L. O. Howard had in mind when he advocated killing mosquito larvæ by the application of a film of oil to the surface of the water. Mosquito larvæ come to the surface to breathe; if there is a film of oil they will be unable to do so. But the amount of oil that used to be applied for this purpose was something like four ounces per hundred square feet of water surface. That works out to give a uniform film about eighteen to twenty microns thick. If you put a film of that thickness on a bowl of water with mosquito larvæ in it, they come to the surface, push their spiracles through the oil and breathe the air quite happily.

Around the openings of the spiracles of mosquito larvæ there are tiny glands which produce a greasy or waxy secretion. This serves to prevent the entry of water into the tracheal system. But, of course, it favours the entry of oil; and as the larva opens its spiracles in contact with the oil film, a little of the oil runs in. Provided it is a pure oil like refined paraffin or olive oil that will not hurt the insect. Indeed some mosquito larvæ can have the entire tracheal system filled with medicinal paraffin without suffering any ill effect at all. They obtain all the oxygen they require from that in solution in the water. Mosquito larvæ are killed by oils only if these contain toxic constituents. Presumably the poisons enter through the thin walls of the final branches, particularly in the ganglia of the nervous system—but at the present time we know little enough of the permeability properties of the tracheal lining.

A somewhat similar story is to be told of some of the pests of horticulture. In the late 'twenties or early 'thirties, sprays of petroleum emulsion provided the answer to the apple capsid problem. The vulnerable stage was the egg, over-wintering in the bark; it was suggested that the eggs were being suffocated by the oil. We now know that oxygen passes very readily through films of paraffin; so that any interference with respiration must be of a rather subtle kind. Actually, it had been shown by Leuckhart in 1855 that the eggs of many insects possess an elaborate respiratory system. This early work had been largely forgotten; but a few years ago Beament and I confirmed and extended it.

In such an insect as the bed-bug *Cimex*, or in *Rhodnius*, there is a ring of pores just behind the cap of the egg. These pores are filled with a protein material which is in the nature of a sponge with air in the meshes. These spongy ducts do not lead directly to the yolk but to a thin layer of similar spongy protein which lines the entire shell. If a drop of a thin oil such as kerosene is applied to the cap of the egg it rapidly displaces the air in this meshwork and spreads all round the lining of the egg, between the egg shell and the yolk. Indeed, Tuft had already measured the oxygen consumption of the egg of *Rhodnius* and had shown by calculation that if the air all entered in the region of the cap it could not diffuse sufficiently rapidly through the substance of the yolk in this elongated egg to provide the amounts of oxygen that are actually consumed; but that if oxygen diffused in a gaseous phase beneath the shell (a process which is, of course, enormously more rapid than diffusion through yolk) then diffusion inwards through the yolk could achieve the rest. Such a system, coupled with an egg covering which is highly impermeable to water, will enable the egg to breathe with a minimal loss of water. Many different modifications of this general plan are to be found in different insect eggs, including (according to preliminary observations) the egg of the red spider mites. Anyone who is thinking at all closely about killing insect eggs by means of chemicals must have this knowledge in the back of his mind.

PHYSIOLOGY AND THE ACTION OF 'AEROSOLS'

Indeed, the most obvious contribution of insect physiology to the study of insecticides is just that: it provides a detailed scientific description of the life

of the insect so that the applied entomologist can think intelligently about his problem. The starting point in the acquisition of such knowledge has often been the simple-minded approach of just looking closely into some practical procedure and seeing at what point it is disrupting the insect machine. The results not only afford the intellectual satisfaction of knowing what is happening—they often provide ideas for improving or maybe revolutionizing the practical methods.

As an example of this I should like to recall briefly the work which David and Bracey carried out on mosquito and fly sprays during the war. You may remember that before the advent of DDT the great problem in this field was to make the limited supplies of pyrethrum go as far as possible. The idea behind this investigation was that if we knew just how space sprays or 'aerosols' worked we might be able to think out improvements to make them more efficient.

It soon appeared that the large droplets in the spray mist fell down to the ground, and that the very small droplets were carried past the insect in the slip stream and had no effect. The most effective droplets in the 'aerosol' were those of intermediate diameter, in the range five to ten microns—but these minute droplets are apt to evaporate rapidly and become reduced below this optimum size. Droplets of this size, however, will not make contact with the insect unless they are in active relative movement: if 'impaction' of the droplets is to take place, either they must be driven in a stream of air, or the insect must be moving. If the mosquito remains at rest in a more or less stationary 'aerosol' cloud it is not affected: it must be in flight. When the mosquito flies, by far the most actively moving parts are the wings, and these do indeed take up by far the greater part of the spray. When the wings become laden with droplets the mosquito seems to become uncomfortable; it settles and cleans the wings with the legs conveying the droplets to all parts of the body, including the sites of entry.

Two practical suggestions come out of these simple physiological observations: (i) Even when other insecticides, such as DDT, are the main killing agents in a spray, it is advantageous to add a little pyrethrum because of the agitation and flight which it induces. (ii) It is an advantage to add a certain amount of some heavier oil to the spray so that the droplets do not become reduced too much in size by evaporation. One such oil was oil of sesame. This proved, however, to be much more effective as an adjuvant than could be accounted for by its reduction of evaporation. In the United States this was traced to the synergistic action of the sesamin in the oil—but that is another story, which is not yet complete.

THE INSECT CUTICLE

Some part of these fly sprays may enter the body of the insect by way of the respiratory system, but the greater part is probably passing through the integument. That applies to many other contact insecticides; and this fact has provided a very great stimulus to the physiological study of the insect cuticle; indeed, during the past ten or fifteen years there has been a complete revolution in our knowledge of the cuticle. We are still hoping that all this increased knowledge will some day provide the answers that the toxicologist requires. So far,

it must be admitted, the cuticle becomes more complex and diverse in its structure every year; its histology and chemistry provide endless opportunities for speculation about the entry of insecticides; but we cannot really claim to understand the laws governing this process.

One point that has been established is I think important. We used to think of the insect as covered by a layer of cells which secreted over themselves a dead, inert cuticle. But now we realize that the cuticle (except perhaps in its horniest excrescences) is a living structure. The cells send filaments of cytoplasm through its substance, which often come exceedingly close to its surface: if the insect is immersed in an oil, tiny droplets of water are quickly exuded from its surface; if the surface of the cuticle is injured in the slightest degree the cells below react as though they had been wounded.

The cuticle is composed of the mucopolysaccharide chitin. In the outer part the protein component is often tanned by quinones produced either by the oxidation of phenolic substances secreted into the cuticle, or by the oxidation of phenolic constituents of the structural proteins themselves. This process renders the substance of the cuticle much more lipophil: these hardened parts contain more or less lipoid and cholesterol.

But the interest of the student of insecticides centres particularly on the outermost layers of the cuticle—the so-called epicuticle. Microscopically this appears as a thin refractile layer, a micron or less in thickness, usually colourless or amber coloured. This layer is exceedingly important in the physiology of the insect because it is the layer responsible for waterproofing; it is also the layer perhaps primarily concerned in keeping out insecticides.

The only way in which it has been possible to gain some idea of the nature of the epicuticle has been to study its deposition when a new cuticle is being formed in preparation for the moulting of the old cuticle. It then appears as an exceedingly complex structure. Before the inner chitin and protein layers are formed the cells first lay down a thin refractile layer of lipoprotein: that is the basic component of the epicuticle. Then, shortly before the old cuticle is shed, and while the chitinous layers are being formed, tiny droplets of some semifluid substance exude from the ends of the cytoplasmic filaments and gradually run together to form a continuous sheet. This material is exceedingly active in reducing ammoniacal silver; and since the commonest constituents of living tissue with this property are phenols, it has been referred to as the 'polyphenol layer'. Very soon a waxy layer begins to appear over the so-called polyphenol layer, and by the time the old cuticle is shed it is completely covered by a thin layer of wax: the new cuticle surface is extremely hydrophobe and ammoniacal silver applied to the surface is no longer reduced because it is separated by wax from the reducing substances below. Finally, at the time of moulting or very shortly afterwards, dermal glands pour out a layer of secretion which spreads over the wax and quickly hardens to form a protective coat—the cement layer. If sections of cuticle are immersed in a wax solvent the cement layer can often be seen to become detached as the wax dissolves; but the other layers can no longer be recognized at being distinct—they may perhaps be fused one with another.

This process of cuticle formation has been observed (with modifications) in a number of widely different insects. But it refers only to the general surface of the external skeleton of the insect; there must be great differences in the special regions of the cuticle which cover the sense organs; and since these regions may be those mainly concerned in the entry of some insecticides one must not expect to deduce too much from a consideration of this standard structure. But there are some points worthy of further consideration.

There can be little doubt that the wax layer is responsible for water-proofing the insect. If it is interrupted, by abrading away the delicate cement layer by which it is covered (by gently touching the surface with fine alumina dust), the rate of loss of water is enormously increased, and the insect soon dies of desiccation. And if limited areas of the cuticle are gently abraded in this way (so that they show no microscopical injury) the entry of such insecticides as rotenone or nicotine, locally applied, is greatly increased.

That naturally raises the question whether the abrasive properties of carrier dusts are important in the practical application of insecticides. There is a little evidence that that may be so; but the researches of David and Gardiner have served to emphasize the enormous complexity of this problem. There are so many variables—the size and shape and the dust particles, their hardness and hygroscopic properties, the microscopic anatomy of the insect, its movements and behaviour in contact with the dust, and so on—that it is difficult in practice to ascribe the increased efficiency of a particular carrier to one property alone.

The toxicologist is faced with the remarkable stability and inertness of the components of the epicuticle. But in order to be laid down at all these components must be mobilized, and in the study of that mobilization we have recently learned a little more about them. In the tick *Ornithodoros*, as studied by Lees and Beament, it seems that the waxy material that is used to waterproof the egg is mobilized and solubilized by association with protein; at the moment of secretion by the gland in question the protein appears to be removed from the scene of action and the wax liberated. Wolfe has described a somewhat similar process in the formation of the wax layer on the adult blowfly. It seems that the protein-containing moulting fluid, in which the adult fly is bathed up to the time of emergence, dries on the surface of the cuticle and in this process the wax crystallizes out. That suggests the possibility that the so-called polyphenol layer may be a similar 'solution' from which the wax layer crystallizes.

Rather more exact information is available about these processes in the cockroach. This insect is waterproofed by means of a mobile grease which permeates the cement layer and is freely exposed on the surface. This material has a consistency resembling that of vaseline. But if a small quantity of it, dissolved from the surface of the cockroach, is left exposed to the air for some weeks or months, it becomes converted into a hard white wax like that of the mealworm or of *Rhodnius*. Beament has shown that that is because, among the long chain paraffins, alcohols and esters which compose the cockroach wax, there are some short chain components in the C_8 or C_9 range which serve as solvents for the long

chain waxes. It is remarkable that a mixture of octyl alcohol and octane has very special solvent properties for such a substance as beeswax, and these properties are identical with those of the distillate from fresh cockroach grease. The toxicologist, interested in rendering this insect wax unstable, may perhaps gain some lead to his ideas from these discoveries.

So far as the cement layer is concerned, this too is a highly resistant substance with fatty or waxy components in some hard matrix. When the lipoid constituents are removed, or at least when the material is treated with hot chloroform, it is found to be intensely reducing towards ammoniacal silver. In the cockroach, Beament has obtained evidence from its solubility and other properties that the cement layer is composed of a substance closely similar to shellac.

But, when all these chemical constituents of the surface layers have been considered, we come back to the point from which we started: the cytoplasm of the living cells extends close to the surface; the cells can control and repair these surface layers; and when we study the entry of chemicals we find that we are faced with a living barrier and not a merely passive structure. The more we study it the more the surface of the insect comes to resemble the surface of the living cell.

THE MODE OF ACTION OF INSECTICIDES

The problem of penetration by the insecticide is thus complicated enough; but when we come to consider the impact of the toxic substance on the living tissues after it has entered, we reach still more difficult problems. In order to convey fully the nature of these difficulties one would have to survey the whole range of insect poisons and their toxicology. That I have neither the time nor the competence to do. All I shall attempt is to remind you of a few of the general principles which have emerged in recent years and to illustrate these with a few examples.

It is always interesting to know how things work—it is that curiosity, of course, which is the spur to all worthwhile research. Over the years there have been papers on the mode of action of pyrethrum and other classic insecticides, and more recently a spate of papers on the mode of action of DDT. Then came the expected development of resistance to DDT and this has added an altogether new intensity to the interest taken in these problems. We want to know as much as possible about the metabolism of insecticides; about their breakdown or their elimination from the body—in the hope that given this knowledge we might be able to circumvent these processes of acquired resistance, by biochemical means.

The same problems arise in connection with the organic phosphorus insecticides. Problems of resistance in the insect are not yet so prominent; but we have the added problems of the high toxicity of these substances to man and the hope that with increased knowledge we might be able to find poisons of this type which are more selective in their action.

All these modern synthetic insecticides have been discovered empirically, in the course of testing long series of chemicals. But once found it is evident that they must intervene in some very special way in the chemical metabolism of the insect. If we had had sufficient prior knowledge of insect biochemistry

it should have been possible to predict the activity of these particular substances; and given sufficient knowledge we should be able to devise molecules which will disrupt the machine at whatever point we might desire. Actually it looks at the present time as though the boot will be on the other leg, and that it is the study of these insecticidal chemicals which will reveal how the physiology of the insect proceeds!

But, after all, it is well to remind ourselves that acetylcholine, for example, was a favourite tool of the pharmacologist long before it was realized that it is actually part of the machinery of the normal heart and nerves; and many years ago it was suggested that for certain purposes noradrenaline would be an improvement on adrenaline: only comparatively recently have we learned that this idea had been thought of long ago by the suprarenal gland. Perhaps in days to come we shall be familiar with some essential constituent of the nervous system which bears a striking resemblance to DDT.

The problems of insect toxicology have, indeed, much in common with those of medical chemotherapy. That again is a field which, since its original exploitation by Paul Ehrlich, has developed in the main empirically. But during the past few years chemotherapy has become increasingly rational. This change has been largely due to the development of prontosil and the sulphanilamide drugs. As is well known, it was shown by Woods that sulphanilamide derivatives exert their anti-bacterial effect by interference with the metabolism of *p*-amino benzoic acid—a bacterial metabolite closely similar in chemical constitution to sulphanilamide itself. This observation was later generalized by Fildes to provide a general theory of chemotherapy: that a chemotherapeutic agent is a substance which interferes with some essential metabolic reaction of the pathogenic micro-organism, and that such substances are to be sought among compounds which show some close chemical similarity to those normally utilized by the organism in its metabolism.

This conception is a special application of Quastel's theory of enzyme inhibition: that enzymes are inhibited by compounds that are so similar stereo-chemically to the normal substrates that they unite with and block the surface of the enzyme. When one pauses to reflect on these interlocking molecules one cannot help calling to mind Ehrlich's prophetic vision of the lock and key mechanism of resistance and immunity.

If we turn to the physiology of insects with these ideas in mind several examples at once catch the eye. The simple sugar mannose is said actually to be poisonous to the bee and wasp (though not to other insects), and this is attributed to the 'competitive inhibition' of some enzyme concerned in the metabolism of glucose. Hydrogen cyanide is a familar insect poison and it has long been known that it acts by interfering with the cytochrome system. As shown by Williams and his colleagues, the pupæ of the American silk moth during diapause are no longer dependent on the cyanide sensitive parts of the cytochrome system for their reduced metabolism: it is scarcely possible to poison these insects by means of cyanide. And, as everyone knows, hydrogen cyanide is no longer effective against certain strains of the red scale of citrus—because these also have modified

their respiratory metabolism and now rely chiefly upon metal-free autoxidizable enzymes, perhaps flavoprotein or perhaps (as in the diapausing silk moth) cytochrome b_5.

Another substance which blocks the synthesis of one or more components of the cytochrome system is diphtheria toxin. This is highly poisonous to the active stages of the American silk moth which are dependent on cytochrome C, but it has virtually no effect on the dormant pupæ in which cytochrome C is lacking.

Diphtheria toxin is scarcely a practical insecticide, but it serves to illustrate the kind of prediction that can be made when the requisite knowledge exists. An example which is rather closer to the possibilities of practise may be taken from the recent work of R. L. Metcalf and his colleagues. They argued as follows: it is well known that the cholinesterase enzyme system is important in the nervous activity of insects. Carbamic acid esters are well-known inhibitors of cholinesterase. They therefore synthesized examples of aromatic esters of carbamic acid with moderate lipoid solubility in the hope of favouring entry through the cuticle—and found that these did in fact act as contact insecticides. The most toxic were those which were least readily hydrolyzed and therefore might be expected to block the enzyme cholinesterase most effectively; and, finally, there was evidence that some particular steric arrangement of the molecule was required to give a good fit.

The inhibition of cholinesterase by organic phosphorus compounds is likewise attributed (for example by Metcalf) to the binding of the central phosphorus atom firmly to the surface of the esterase enzyme in such a way that it blocks the access of the normal enzyme substrate, acetylcholine. Acetylcholine therefore accumulates and the insect poisons itself with a normal constituent of its tissues.

Another phenomenon that is becoming increasingly familiar, both in human and insect toxicology, is the 'autointoxication' of organisms: presented with an unfamiliar substance they metabolize it partially with the formation of some product which sufficiently resembles a natural metabolite to cause it to 'block' some enzyme system. The classic example is the South African poison plant or 'gifblaar' (*Dichapetalum cymosum*). The poisonous substance in this plant is fluoroacetic acid. But as Peters and his colleagues have shown, fluoroacetate itself is not toxic to enzymes; it is converted by the enzymes in the tissues to a fluorotricarboxylic acid (probably fluorocitric acid) which inhibits aconitase—an essential enzyme in the tricarboxylic acid cycle. In a similar way demeton is metabolized in the plant with the formation of much more poisonous products; and in both insects and mammals it is not schradan itself which is the toxic anticholinesterase: it is first converted to the active product by the tissues themselves.

This same principle of the blocking of enzymes can be used in another way. Insects which have become resistant to DDT have developed enzyme systems by which DDT is broken down to non-toxic products. But it is possible to introduce substances which sufficiently resemble DDT to block this DDT—

dehydrochlorinase enzyme and which thus act as synergists that serve to increase the susceptibility of those insects which have become resistant—although, of course, they have no such synergistic action in ordinary susceptible insects.

It seems to be generally agreed that an enhanced capacity for detoxication is an important element in 'resistance' to insecticides. But one puzzling feature is that the resistant insect may still contain a large amount of the insecticide in the unchanged state. That has led to the suggestion that the important factor may be local detoxication at some key site.

Now many of the insecticides with which we are concerned are nerve poisons, and it is interesting to realize that the blood of the normal insect contains a nerve poison so potent that if the nerve axons are exposed to it they are unable to function.

That poison is potassium. But the entire nervous system in the insect, from the ganglia right down to the smallest nerves, is enclosed in a protective coat: a fibrous sheath or 'perilemma' and an underlying cytoplasmic sheath or 'perineurium'. As Hoyle has shown, if this sheath is punctured, so that the enclosed axons are exposed to the potassium-rich blood, they will no longer conduct nerve impulses.

It is highly probable that the exclusion of potassium by this sheath is an active process, an 'active transport' or 'secretion' for which energy will be required. It is not surprising, therefore, to find, as I have recently found, that the cytoplasm of the perineurium is exceptionally rich in enzymes: the succinic dehydrogenase—cytochrome oxidase system, esterase, and so forth. If this enzyme system can act upon our insecticides, it may well be responsible both for the protection of the sensitive axons from chlorinated insecticides by detoxication and for the local production of toxic derivatives of organophosphorus insecticides.

But there is another recent development in medical chemotherapy to which I must refer. Procedures are being devised which serve to bring about some alteration in the metabolism of the host, which is trivial so far as it is concerned, but which is disastrous for the parasite. Folic acid antagonists form one such example. Or, alternatively, dietary or therapeutic measures may bring about some change in the host which serves to increase its normal powers of resistance: diet may have a profound effect on resistance to malaria; certain surface-active compounds of high molecular weight can stimulate to a remarkable degree the natural cellular defences against the tubercle bacillus.

Have we a lead here which might be useful to the plant pathologist? There are three ways which are being exploited at the present time to render plants resistant to insects: the introduction of systemic insecticides, the breeding of resistant varieties, and the age-old cultural methods which aim at producing a plant in such a physiological state that it can withstand insect attack. The resistance of particular varieties appears often to depend upon some subtle change which leads to the insect growing or reproducing more slowly. The Colorado potato beetle which thrives so well on the ordinary potato ***Solanum tuberosum***, appears to feed quite happily on the closely related ***Solanum demissum*** but it grows more slowly and is hardly able to reproduce. The same thing can be

seen in a single plant under different physiological conditions. As Kennedy and Booth have shown, young shoots or wilting leaves of beans are much the more favourable for aphides—because they are the richest in nitrogenous compounds in process of mobilization.

Could we aim at inducing such chemical changes in the plant by chemical means? So that by applying some harmless chemical to the plant its metabolism may be so affected that while it will remain unchanged so far as man's requirements go, it may become ill-suited as a host for the insect pest. That would indeed be a beneficent sphere of activity in which the chemist might still further display his talents.

DISCUSSION

MR. J. H. STAPLEY: I was interested in Professor Wigglesworth's reference to the killing of capsid eggs—naturally a subject very near to our activities, but I thought he oversimplified it by saying that it was due to the way the oil blocked the entry of air. The problem as it came to us twenty years ago was that one type of oil, that is mineral oil, apparently killed the eggs, but tar oil, which is also used for killing insect eggs, did not affect the capsid eggs. It seems rather odd that if the mechanism is a physical one like the oil blocking its cells, it should fit one type of oil and not another. I wonder if there is a lot more to the explanation than that?

THE LECTURER: I am sure that Mr. Stapley is right, and there is a great deal more to the explanation than that, but of course some of the eggs in which tar oils were most effective were ones which have a very much more permeable shell and do not have an elaborate respiratory system of this kind, so I think there is information here which serves as a very useful background for thought, although I entirely agree with him that this is not the complete explanation.

MR. W. H. POTTS: Professor Wigglesworth's reference to the insects which did not rely upon the usual enzyme system for oxidation and were therefore not destroyed by hydrogen cyanide gas, reminds me of an experience a colleague of mine, Dr. E. Burtt, had in East Africa when he was studying colour changes of acridids in that area, which take place seasonally. He found that he could bring about these colour changes from green to black by exposing the grasshoppers to insolation against a dark background, or under dark conditions, and those which darkened were impervious to the ordinary killing bottle of hydrogen cyanide, whereas I believe they were susceptible before. Does Professor Wigglesworth know of any similar occurrence by which insects which relied on one system of oxidation could change to another?

THE LECTURER: This is a most interesting observation of Mr. Potts'. Now that Dr. Uvarov's Locust Centre has a strain of albino locusts, there might be something interesting here to look into.

MR. K. F. GOODWIN BAILEY: In his reference to the use of carriers for insecticides, Professor Wigglesworth mentioned the abrasive properties of certain dusts and that it had not been possible to observe abrasions on microscopical examination. Has he any observation to make on the possibility that it may not be the abrasive properties of a carrier but absorptive property that is operating?

THE LECTURER: The abrasion cannot be seen microscopically—that is, by just looking at the cuticle unprepared under the microscope; but that abrasion has really taken place is readily proved by immersing the insect in ammoniacal silver.

Any point where even the slightest abrasion of the surface layer has occurred is actively reduced, and the effect is proved very strikingly.

MR. K. F. GOODWIN BAILEY: Is there any information about absorptive properties of carriers in relation to their toxicity to insects?

THE LECTURER: I take it that you mean in dehydrating the insect. I think that certainly does play a part. The work of David and others has shown that the hygroscopic properties of the dust are important.

THE CHAIRMAN: On that particular point I was under the impression that ground diamond was the most efficient. I cannot imagine that ground diamond is very absorbent.

THE LECTURER: Aluminar is certainly absorbent.

MR. J. R. BUSVINE: I was very interested in the point about calcium and potassium balance in nerve sheath. Is it true that if potassium salts can be injected underneath this neurilemma effects such as those obtained with D.D.T. result? I presume it could not be done with intact insects, but only by observations on action potentials in nerve preparations. It would seem that D.D.T. poisons this membrane to prevent it holding the potassium out.

THE LECTURER: I did not get quite so far as to suggest that, but you could certainly suggest it. You are quite right. Hoyle showed that in the intact nerve, if he injected potassium-containing Ringer, or the blood of the insect itself, which contains too much potassium, then the nerve would not conduct. Whether the actual effect on the nerve is closely similar to the action of D.D.T. I could not say, but it is certainly a nerve poison.

The other possibility is that you might have an insecticide which paralyzed and poisoned the sheath and allowed the insect to poison itself with its own potassium. That would be quite a nice type of insecticide!

All I was suggesting was that possibly in the D.D.T. resistant insect the locally important enzyme system might be this one in the nerve sheath, detoxicating that part of the D.D.T. which would otherwise get through to the nerve.

THE CHAIRMAN: It sounds as if Dr. Busvine is making suggestions that call for experimental verification!

MR. J. WARD: Professor Wigglesworth mentioned that octyl alcohol and octane mixtures had special properties with regard to the insect wax layer. Can he amplify that at all, and tell me what properties they have towards the wax layer?

THE LECTURER: I am afraid that I have not handled these materials myself; I am quoting Dr. Beament's work. The most striking effect is that most other wax solvents will hold a certain amount of wax and that is all. But mixtures of octyl alcohol and octane will mix with wax in all proportions so that you can get a vaseline-like material. Then these solutions will spread remarkably effectively over surfaces. I think there is rather more to it than that, but those are the two most striking observations which I remember.

DR. P. A. HARLOW: I should like to ask Professor Wigglesworth about the esterases in the membranes surrounding the nerve, which are possibly also in the membranes surrounding the ganglia. If there are hyper-esterases there, it seems possible that when something like acetylcholine is injected into the insect, which does not have a physiological effect when that is done, the esterases may break it down before it gets into the ganglia.

I have actually tried to get acetylcholine through this membrane in the same way as Mr. Hoyle did through the nerve, and found that it did not give an increased physiological action that way.

THE LECTURER: I take it that you got no effect after the injection of acetylcholine. Actually that does not surprise me, because the nervous system takes the utmost care to protect itself against acetylcholine, and not only are there esterases in the sheath but the whole of the nerve in among the axons is very rich in esterase. That applies in the entire nervous system, so that it is very difficult to get at.

THE CHAIRMAN: I should like to thank Professor Wigglesworth on your behalf. He has stated and underlined several times the undoubted fact that the new items of information that are coming out of the work of himself and his colleagues, and of course similar research schools, are fundamental to further advances in the efficient use of insecticides. Unfortunately he does not make life too simple for we poor chemists. To take the very simple case, as he called it, of the epidermis of an insect. I get the impression that if we want to get a chemical fluid through that epidermis, it is not a matter of getting from Base Camp to the top of Everest, we must get from Base Camp to Camp 1, and with great difficulty to Camp 2, Camp 3, and so on. It sounds very complicated.

I mentioned in my opening remarks that the problem of translating research results into techniques useful in agriculture is very difficult. Whilst some of the things that Professor Wigglesworth has said this afternoon are doubtless beyond the immediate ken of farmers or even of people suffering from body lice, it is up to us in industry to apply these results of his research to our work and together find answers to many world problems.

May I, on your behalf and my own, thank Professor Wigglesworth for his lucid and illuminating address.

A vote of thanks to the Lecturer was carried with acclamation.

MR. A. R. N. ROBERTS (A Member of Council of the Society): May I claim the privilege, on behalf of the Council of the Royal Society of Arts, of our distinguished lecturer and I am sure of yourselves, of expressing our warm thanks to Dr. Holmes, our chairman, for his conduct of the chair.

I do not think there is any worker in his sphere who better exemplifies the motto of the Royal Agricultural Society of England: practice with science. Dr. Holmes was brought up in rural Warwickshire, and in his studies of the best means of controlling crop pests and diseases he has never forgotten the doubts and the difficulties of the man on the job, a thing which the scientist who wraps himself in the ivory tower is so apt to do. Therefore I think it was altogether appropriate, when Constable's published a book from his pen last year, that it should bear the title of *Practical Plant Protection*. Of course, that fact that Dr. Holmes is the Technical Director of Plant Protection Ltd. was, as they say, purely coincidental.

Dr. Holmes has not confined his studies to this country. There is probably no worker in his sphere who has such a world-wide knowledge of these problems as reposes in his own head. That, I think, is one of the reasons why he will never be known as 'one of the stately Holmes of England'!

There are two other reasons; one, as a church worker at Fernhurst once put it to me, is his fondness for stories which are perhaps a trifle racey, and the other is, and here I speak from personal knowledge, that he is much too good a colleague and friend ever to stand on his dignity by keeping his wide knowledge to himself. He is, in fact, ever willing completely to share it with anyone whom it may help.

So, Sir, I would like to thank you, not only for your conduct of the chair this afternoon, but for half a lifetime of unselfish service to the solution of one of the major problems which affects a hungry world.

A vote of thanks to the Chairman was carried with acclamation and the meeting then ended.

DESIGN FOR TELEVISION

A paper by

F. H. K. HENRION, M.B.E., F.S.I.A.,

read to the Society on Wednesday, 1st February, 1956, with Sir Kenneth Clark, K.C.B., Chairman, Arts Council of Great Britain, and of the Independent Television Authority, in the Chair

THE CHAIRMAN: I am going to ask permission to draw a distinction between an *élite* and a mandarin class. It is axiomatic that no society can prosper unless a few of its members, be they shop stewards or commissars, or members of the orders of chivalry, are willing to assume the responsibilities of leadership. In an *élite*, as I define it, this responsible minority has grown out of the mass and is rooted in the same soil and speaks the same language. The members of the English governing class who passed the Reform Bill of 1832 were an *élite*; they differed from the people they governed in wealth, in opportunity, and in education, but they were basically in agreement with them. They shared the same prejudice, they had interest in the same things, in the same sports, in farming, they even shared in some of their disreputable pleasures.

As for the mandarin class, apart from mandarins whom I suppose have not been maligned in this respect the classic example is pre-revolutionary Versailles, that strange world of its own, ignorant of everything that was going on in France, even referring to itself as a different country as *ce pays ci*.

I think it is hardly necessary for me to tell you how this distinction applies to the subject we are going to consider this afternoon. Almost every educated person I have ever met says to me with a self-satisfied smirk, 'I am afraid I have not got a television set'. There are many good reasons for this, some people are too busy, others have interests which they do not wish to see interfered with; and perhaps there is a reason within the television programmes themselves. But seen as a whole I think that this particular relation of haves to have nots (which as you know is almost an inversion of the old haves and have nots) is exceedingly dangerous. It is going to create a cleavage in those basic interests and points of agreement, even a difference of language, and that cleavage as I have just suggested is what distinguishes a mandarin class from an *élite*.

It is therefore with rising spirits that I welcome anyone with the intelligence and experience of Mr. Henrion who has had the far-sightedness and the sense of his own times to apply his mind to the problem of television. There are, of course, a lot of very clever people applying their minds to television, but they are all concerned with the immediate problem of how to get through the evening, how to feed this insatiable medium which allows them no opportunity to take a longer view. Now we are going to be shown a longer view.

The following paper, which was illustrated with lantern slides and a film, was then read:

THE PAPER

I hope I will be permitted to treat the subject of this talk in its wider application. It is ordinarily assumed that the designer's *rôle* in television is that of

a man who designs the settings and is responsible for the costumes and all incidental properties, as well as devising titles for particular programmes. But it is not my intention to deal with this particular aspect of a designer's activity, as there are doubtless others who have greater experience in this field, and also because the designer's contribution is accepted here—indeed it is required. What I should like to take as my theme is the potential contribution of the designer to television as a medium; for there his contribution, though required, is so far not accepted at all. As it is primarily a visual medium, the man who makes visual expression and visual communication his job would be obviously the one who could control it most efficiently and—at its most ambitious—conceive of it as a work of art. These may seem high-sounding words but, judging by what we are mostly offered by television, both here and overseas, it is essential that our standards should be pitched as high as possible. I should like to impress upon you the potentially shattering influence of television in almost all the spheres of our cultural life. There has never been a medium which has wielded such power in forming opinion, influencing people in their habits and their appreciation or rejection of things and values.

To-day we are becoming used to situations where the ordinary man is faced with the almost unimaginable, with the result that the imagination fails. Where a million is a very great quantity, a billion—to the tired mind—just seems a little bit more. The atom bomb in its effects presents quantities and volumes which most of us fail to fathom, and the hydrogen bomb seems to be beyond all comprehension compared with that already out-of-date device which was dropped on Japan. I submit that television in its effect on the public fails similarly to impress its undreamt-of potential power.

Nobody who is interested in visual communication and in social and spiritual progress through it can afford to ignore, or even fail to interest himself in, this all-powerful medium. The intellectually snobbish attitude of priding oneself in not having a television set is out of date, and equals that of people who adopt an understandable though indefensible attitude in trying to ignore potential effects of nuclear fission and what they could mean to all of us. To illustrate this statement I would take two examples. The first is *Oedipus Rex*, a drama written 2,500 years ago, translated into most modern languages, and enacted many thousands of times from the period when Sophocles wrote it to the present day. It is possibly the best known classic drama typical to all mankind, already existing as a myth before Sophocles wrote it, and still pervading our whole mental and psychological life. The second example is the most popular television programme yet devised: 'The $64,000 Question', an American programme, sponsored by a cosmetic manufacturer, which has reached an audience of fifty million people. This programme consists of somebody who claims to be an expert on a particular subject being asked questions on it: if he gets the right answer his reward, starting at $1,000, is doubled with each subsequent correct answer; but if he cannot find it in a given time, he foregoes the lot. So far a few people have gone up to $32,000, then hesitated to go beyond it, risking the loss of $32,000 to win $64,000. The whole nation, through press and radio, joined

them in their agonized decision whether or not to go on with the contest. One of them sought guidance from priests and spent days in prayer before he made up his mind to stop at $32,000, having by then become a national hero. In the end, a marine captain braved the risk and won the whole prize and the entire nation, in self-identification, suffered with him the underlying greed, the emotions and the anguish. Exact statistics are naturally not available, but it is probable that the audience of this ten-minute spectacle numbers more than the sum total of all audiences, throughout the world, who have ever watched *Oedipus Rex* in the last 2,500 years. This consideration seems to me frightening; at the same time it shows the fantastic power wielded by the invention which, according to an American writer, consisted in making a piece of living-room furniture light up. This power is even more difficult to grasp, as the comedian making a stale joke to the cold eye of a camera in a sealed-off studio must find it difficult to realize how, at the time of speaking, his joke will be received up and down the country, in the suburbs, the pubs and hospitals. He can hardly conceive the million homes in which this joke falls flat. Likewise it is even more difficult for the audience to realize how very many others are suffering this joke, as the audience is usually divided into such small groups, of an average of three persons, gazing patiently at the lighted window in their furniture.

I have dwelt at such length on this particular aspect in the hope of shaking out of their complacency those who are concerned with the spreading of ideas, knowledge, and entertainment to the majority of the people. But what can be done? Being a designer, I should like to approach this problem as a normal job in which I am asked to design in a new medium, such as glass or plastics for instance. I should try to analyze and understand the peculiarities of the medium, try to determine its limitations, and thereby its scope. It is a fair criticism to say that if a solution is true to its medium, and cannot be emulated in any other medium, though it may not be necessarily a work of art, it is nevertheless a creative step in the right direction. A painting which looks like a photograph or a photograph which looks like a painting cannot be the best of its kind. A photograph which conveys something which photography can convey better than any other process is truer to its medium, and therefore of greater value. I should like, therefore, to attempt to investigate where television is peculiar to itself, and try to find ways in which it can convey things unlike any other medium. In his great essay, John Locke divided all that can fall within the compass of human understanding into three categories. The first he called *Physica* (the knowledge of things as they are . . . the constitutions, properties and operations); the second *Practica* ('The skill of right applying . . . which leads to happiness'); finally *Semiotic* (the doctrine of science . . . to consider the nature of science the mind makes use of for the understanding of things, or conveying its knowledge to others, including language and other ways of communication). The formula cannot be improved, and if applied to television might lead to the answers we vainly seek to-day.

But I am afraid I shall not be able to go all that way—in fact, all I will attempt to do is to try to analyze what we know of television as it is and to try to observe

what constitutes its properties and how it operates. With luck this might lead us to the second heading, *Practica.* I fear I will fall short there of suggestions. As to *Semiotic*—the doctrine of communications in our particular case, the science of rightly applying the skill which leads to happiness in textbook form, this, I am afraid, I cannot even attempt. All I know is that Locke's sequence is the right one and that at most I can express a hope that others will follow on in the spirit of the second and third headings, whilst I stumble over the first. Of course, everybody directly concerned in television to-day is much too busy preparing, devising, and producing programmes to fill the avid screens; so guidance will have to be sought from a neutral observer stationed neither at the source nor at the receiving end, but assessing both with understanding and sympathy. Again, I am not suggesting that I am this selected observer, but I will try to assess what I see, at least from that neutral position being neither too much involved in the programme making, nor unduly in the viewing, in so far as many of my evenings are reserved for other occupations.

The observations I am going to make are based on occasional work I have done for the B.B.C. from time to time over the last ten years; they are derived from more recent experience in the preparation and execution of advertising spots, and a journey—a few months ago—to the United States where I saw a good deal of television, and visited several studios of N.B.C. and C.B.S.

First of all, there is one field in which television is at its best. It is in the straight reporting of events, not after they have happened—as is the case with newsreels—but as they are happening. This superficially unimportant fact matters very much, however, because viewing is topical, and what is seen happens before it has become history. The sports event, whilst the game's decision is in the balance, will thrill much more than a recording screened afterwards. The Coronation was unquestionably the high spot of television reporting; it was seen as a historical ceremony unfolding itself; with the result that the viewer participated in the event, hobnobbed with the great, and looked-in with the crowd on the screen. The result was more than communication; it was emotional communion, mixing across the screen with the great of the world, with the images of living royalty and nobility. But coronations are not yearly events and, sports and games apart, most of the television news is recorded at the time but only shown after the event in the same way as film news. Similarly we can take part in a play which is sent out from a West End theatre, but in that case the viewer experiences the play less directly than those watching from the stalls and balconies; there is a strong second-hand flavour about it. Plays especially written for television are obviously very much better because the limitations of the medium are taken into account. The producer is aware of the smallness of the screen and produces a play in a more intimate way than his colleague of the theatre. The B.B.C. has attempted to commission special plays for television with varying degrees of success but in a praiseworthy spirit to produce something in the terms of the medium.

Panel games have proved popular and some have been very successful. It is only fair to say that one of the causes of their success is that the viewers are told

beforehand the correct answer to a problem which is then put to a panel of well-known and distinguished experts. Consequently the viewers enjoy—without effort—the privilege of having more knowledge than the expert. Others, however, especially the televized humiliation of members of a theatre audience rewarded by a prize for their public suffering, fall well below the standards of decency and dignity. Is it the lowest common denominator which dictates the programme, or could we not aim at the highest common multiple? In Jean Cocteau's words, 'Is the plural to dictate to the singular?' or is it the moral duty of the gifted few to give what they have to the many?

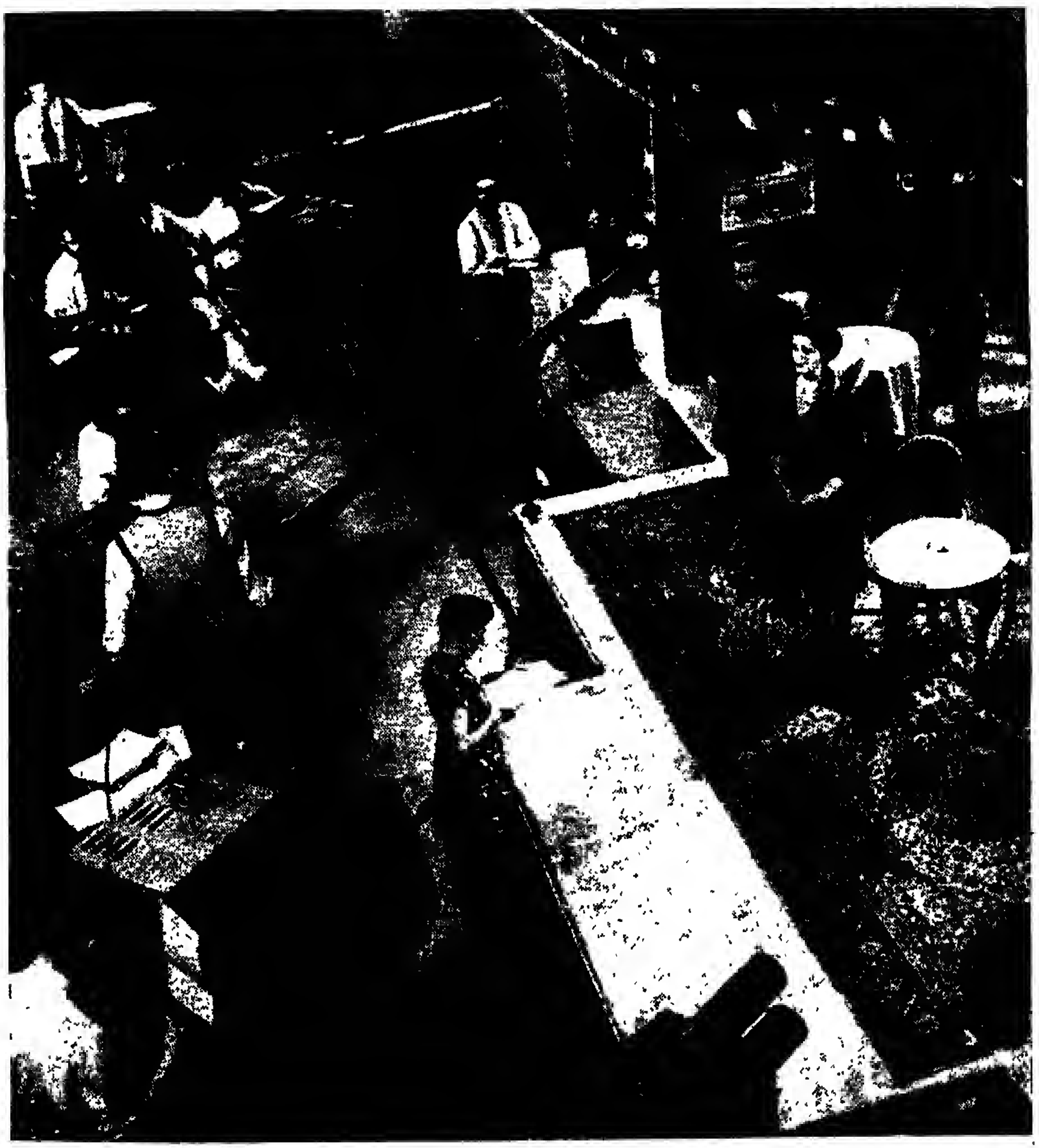

FIGURE 1. *In the studio; four cameras with their various studio managers and so on, shooting a play*

It is often advocated: give the people what they want. Vast sums of money and energy are spent on research to find out exactly what this is, in order to give it to them. People thus asked are, of course, already conditioned by previous broadcasts, and such is the power of television that in all likelihood you get no more than a playback of what you have already seen. Testing can never be creative, only re-creative. If you shout into a wood, you have a fair expectation of what the echo will be like, if there is an echo. Testing is only a stimulated artificial echo, not even a spontaneous reaction. Nothing is more dangerous than to put the chart before the course, the ever-increasing practice of trying to make a creative force of statistics which are at best only a record of facts, and very often only irrational reactions falsely rationalized by the observer or field-worker.

Of course, there is yet another danger to this medium of television; it is the automatic fascination of the moving image focused on the lit-up screen in the darkened room. There is no merit in the pendulum itself which, swinging in front of one's eyes, mesmerizes and fascinates. It is merely a phenomenon, and the television image exercises a similar effect on the viewer, irrespective of what the moving image tries to convey, thereby numbing discrimination and judgment. I have seen people switching off the sound because it bored them and interfered with their conversation, yet still looking with fascination at the moving picture. The fact that television has this easy fascination, no matter what it shows, is a dangerous temptation for those whose job it is to fill the ether with pictures for 15 hours a day, to send whatever is easy, economical and available. Many television critics in the more serious newspapers and periodicals make sincere and honest efforts to criticize what is shown. They make a valid contribution but, as most of them do not in any way represent the opinion or judgment of the vast mass of viewers, their cries in the wilderness are not always taken as seriously as they deserve by the programme makers.

If you go to a theatre, you have to select the play, reserve seats, dress specially for the occasion, and arrive in time to enjoy the spectacle selected. If you go to the cinema, you have to go through some similar process of selection; you have to queue, or at least make some effort in return for your three hours' entertainment, information or escape; not so television. It is laid on like a service, such as water, electricity, or gas, but with a difference: you only turn on the water when you need it; and if you leave it on without using it, it will probably damage your furniture, floor and belongings. Electricity does not flow out of lamp sockets, as was imagined by James Thurber's aunt. A lamp has to be in the socket, in fact it has to be used, otherwise the current stays within its circuit. Gas has to be burned to be used, and if you turn it on without using it, it will eventually kill all the people in the room. This latest service, however, television, can be turned on without being used. Indeed it is turned on thus very often and people look at it without seeing it. The effect may be mentally asphyxiating, but the results are less obviously dramatic than in the case of the turned-on, unlit gas tap. This situation, which may vary in degrees, is another complication of the medium. Viewers are easily fascinated but not basically interested, so that they are both too lazy to switch it off and too lazy to watch with any measure of concentration.

FIGURE 2. *In the control room; the producer with vision mixer, secretary, technician and lighting engineer*

The obvious difference between radio and television is that a visual message has been added to the sound, or in the special American kind of television language which has developed: to audio is added video. In many programmes, however, one is painfully aware that vision has been added to a purely acoustic programme. It is not good enough to see and hear somebody talk, and although it is fascinating to know what speakers look like, to be able to see them speak does not justify the purchase of a television set, or the very expensive transmission of a talk.

It would seem that there is little difference between the cinema and television, but this illusion is a dangerous one. The television screen is intimate, asking and admitting only a small audience, so that anything shown is much more concentrated and of necessity simpler than in the cinema (it is perhaps symptomatic that, as the television habit becomes more and more accepted throughout all houses up and down the country, conditioning people to concentrate on a small intimate, domestic screen, the cinema screen should expand and grow to 3D, Cinerama, Vista-Vision, and Cinemascope, this latter name being perhaps the most typical, as all these new developments give new scope to the cinema as a medium distinctly different in use and purpose from television). As the television screen invites simple objects, concentrated action and simplicity, the new cinematic developments herald new complications and stunning actions

for our eyes and ears. We are being visibly and audibly assaulted and overwhelmed; stereophonically and stereoptically we might yet turn to our television set as a quiet and simple comforter to our outraged senses. As in the cinema the picture is transmitted in motion, but in this television is unique: it has conquered time and space, and the audience can take part and observe an event whilst it happens. In fact, something unheard of is possible, the subject can objectively view itself. A man can sit with a camera at both his sides, his back and front, and see himself in movement simultaneously from all sides—a measure of empirical objectivity hitherto unachieved. This man can look at himself from all sides in four separate monitor sets, or all four pictures can be superimposed on one screen, so that he can combine the separate visual experience of four observers placed around him. To put it more dramatically, a jockey on horseback with a small monitor set on his saddle could see an air view of himself and all his other competitors, a close-up of the public watching him, see himself overtaking the leading horse, and, whilst experiencing his victory, can watch the judges and crowds reacting to it. I am not suggesting that an experiment of this kind would provide an entertaining evening's programme, but it shows the direction which television can explore to achieve something nothing else can do. I give another example of how the simultaneous superimposition of pictures can create fascinating results. Sir Francis Galton tried to superimpose a number of photographs of members of the same family in order to lose the individual and achieve the family face, the common denominator—in fact, visual mathematics (Figure 3). Reading about his experiments, made in 1890, I tried to establish in static photography the typical faces of an American and a British car by superimposing twenty car faces of each nation (Figure 4). With motion added I can see exciting possibilities, not necessarily brought to this extreme, but making a more creative visual use of the present studio technique.

FIGURE 3. *Specimens of composite portraiture, personal and family. A number of photographs of members of the same family were superimposed to lose the individual and achieve the family face. An experiment carried out by Sir Francis Galton in 1890*

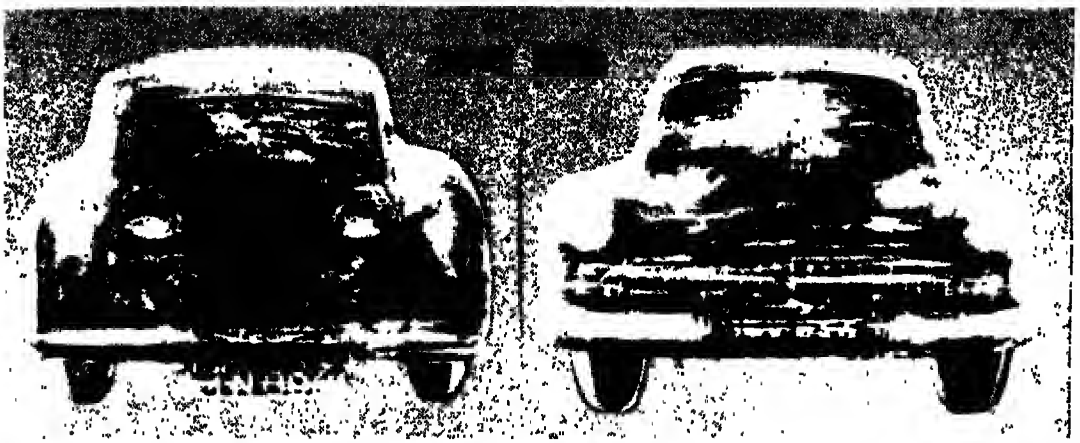

FIGURE 4. *The photograph shows twenty car faces of British* (left) *and American* (right) *cars superimposed. Magazine layout, 1950, by the lecturer, based on Sir Francis Galton's experiment*

Figure 5 shows what usually happens in a studio when four cameras, shooting the same object from different angles and distances, are connected with a different monitor. The producer, like the Air Marshal in Bomber Command, directs, through one girl in charge of all monitors, which picture should go into the air; it can be seen that this man controls entirely what the viewer sees, and from which angle and in which sequence. Ideally, everything should be planned beforehand so that a fascinating sequence of close-ups, longshots, midshots, and so on, is achieved. What, however, often happens, especially if two or more people speak together, is that the producer acts more like his war colleague, the Air Marshal, and switches cameras off and on in an effort to keep track with a conversation, showing whichever face belongs to the speaker at the time, acting more like an air gunner keeping an enemy plane in his range, than one who controls and composes a message of visual as well as acoustic merit.

Of course, the difficulties of devising and directing a programme are enormous, and worse than any, perhaps, is the fact, again unique to television, that at the moment the picture appears on the screen and comes to life, it has already died, never to be seen again—unless it is filmed for later reshowing. In the theatre a play is acted, repeated, and all the performance gradually improved. The film has a claim on time and can be repeated in many countries for many years. A piece of music can be performed and can be perfected. In fact, a work of art has as its main criterion the value and appreciation it achieves with time. Giberti worked for 27 years on the bronze doors of the Florence Baptistry and this work has been appreciated for 500 years and probably will be for a long time to come. A television programme, however ingenious, is doomed to die as soon as it sees the light, only creating another emptiness immediately it is over. This must be a frustrating prospect for any creative man. In fact, it must be fully realized how extremely difficult it is to fill the air with pictures hour after hour, day after

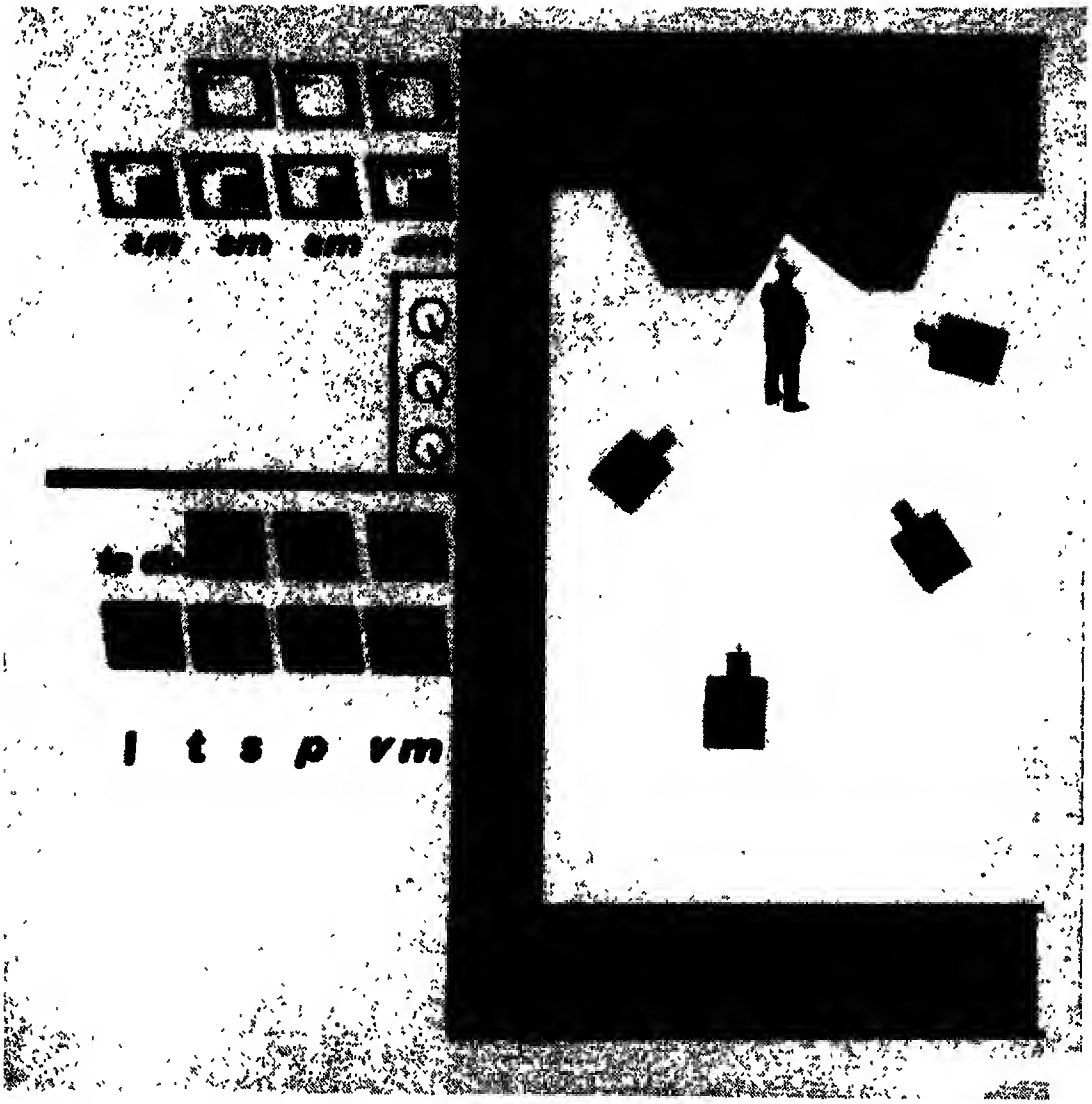

FIGURE 5. *This explains Figures 1 and 2, showing how monitor sets in vision mixing and sound mixing tie up with the cameras in the studio. sm = sound mixer; vm = vision mixer; p = producer; s = secretary; t = technician and l = lighting director*

day, and any criticism I am voicing here is not directed against the many devoted (and persevering!) men and women who fill the void of this Danaid tub. The barrel which sprang ever-new leaks as the poor creatures tried to fill it was a symbol of endless torture in antique Greece. Television presents a contemporary equivalent. So any man devising or producing television programmes must have our sympathy, but at the same time we must also remember that he can reach and influence a potential fifty million people. This puts an enormous responsibility on the thus frustrated producer, but in view of the sheer numbers our concern must be more for the fifty million and the effect the programme has on them. Moreover, physical difficulties in producing any programme are enormous, as anything which is done depends on the collaboration of many people who have not only to be co-ordinated, but won over as willing members of a team. Once an idea is conceived, it has to be realized with the help

of technicians, administrators, and all the various levels of help which delegation entails. The director has to know about the limitations and scope of lighting in order to persuade electricians to give him the effect he requires. He must be an expert in human relations and a leader of men, as well as an able administrator and delegator in filling his whole team with enthusiasm for his project, overcoming with them—not against them—any technical obstacles; yet in the process of seeing to all this, he must not lose or dilute his original conception.

I am now speaking of television programmes where television is used as a creative medium true to itself, rather than as a mere recording of events, talks, plays, music, or other entertainment. It is only in this possibly narrow sphere that it could ever aspire to be an art form. Experimentation and research in this field would lead to finding new visual techniques, and in turn all the other programmes would benefit from them. It is astonishing to see how very soon after the motion picture was invented imaginative people in most countries exploited the new medium, and did exactly what I am trying now to advocate for television, namely developed new techniques to create an entertainment of a kind which could only be approached by the cinema. Melies, and other film pioneers, created the basis on which the René Claires, Pabsts and Hitchcocks of to-day were enabled to achieve their masterpieces. The use of simple visual patterns could be intriguing and become meaningful where a word key is supplied. A line, a semi-oval and a triangle may represent—as Annibale Carracci showed—a blind beggar feeling his way around a corner, or a knight riding to a banquet,

FIGURE 6. *Still of* Le Portrait Vivant, *Zecca, 1904, exploiting a technique of double exposure*

FIGURE 7. *Annibale Carracci showed a blind beggar feeling his way around a corner (vertical view), or a knight riding to a banquet, lance over his shoulder (horizontal view)*

lance over his shoulder (Figure 7) behind a wall. Without this key we only see a meaningless geometrical configuration. Given the key, we instantaneously relate these forms by seeing before our mind's eye what is not represented behind the wall. It seems to me that a lot can be learned for television from this seventeenth-century example. These various illustrations will underline my claim that in this field of experimental television the man best suited for the job is a 'visual' man who has studied visual problems, who is naturally talented in his craft and has by training and experience enlarged his talents, and who is able to apply his talent and his experience, his irrational gifts and his rational mind, to the job. This man can only be a designer and at that one who in addition to all the qualities enumerated must have great organizing and administrative capacity, which should not, however, overshadow his creative work.

At the beginning of my paper I quoted Locke's three points, stating that I could only attempt to deal with the first, and indicate directions towards the second, leaving the third to future developments. Likewise, in trying to find this man, the ideal television producer, I can only point to the likely profession from which he may come, and hope that some institutions will lead the way by training the most gifted students and so produce such a man. No effort should be spared, and no experience either, as eventually these people will be responsible for the state of mind of fifty million people. One of the first steps would be to have an experimental television studio with a closed circuit where, with at least three cameras, new ways could be pioneered without subjecting the public to each experiment which seems necessary at present. The fact that directors and producers can only experiment when they are on the air means that necessarily the edge is taken off anything which is unorthodox or new, in case it may offend or fail.

Everything which happens objectively on the studio floor is transmitted subjectively through the director's eyes which guide and direct the camera lenses. The same performance can be reported by different directors in as many different ways, to make it exciting, revealing and delightful, or the reverse. A man with an unreceptive eye can go to the Far East and back and merely report on a dull journey; another, with a curious and discriminating eye, can discover new excitement and revelations in five minutes on his daily walk to work.

I heard and saw one of our most eminent conductors recently, performing, with a large orchestra, most excellent music. Although the cameras were very active, showing each instrument as it came into action, interspersed with shots of the conductor's face and hands, I found the performance visually an embarrassment which made me long to turn off the vision, as only the sound was pertinent and enjoyable. Despite the fact that something was happening all the time on the screen one could not help feeling, as on so many other occasions, such as listening to a one-man talk and watching the speaker's face all the time, that only the poorest and most obvious use had been made of a brave new medium.

As this one pair of eyes guides and leads potentially fifty million other pairs, it is worth making every possible effort to find and train the first pair before they guide those millions of others. Producers and directors must be visual men, and visual men must be producers and directors. To paint backgrounds, to design costumes and graphic effects is most important, but, however gifted and inspired the men and women in these jobs may be, it is but of small avail unless their work is shown at its best and made part of a visually exciting continuity conceived in advance and worked out in detail. It is not sufficient to produce sound which has to be accompanied willy nilly visually because the medium is received through eyes as well as ears.

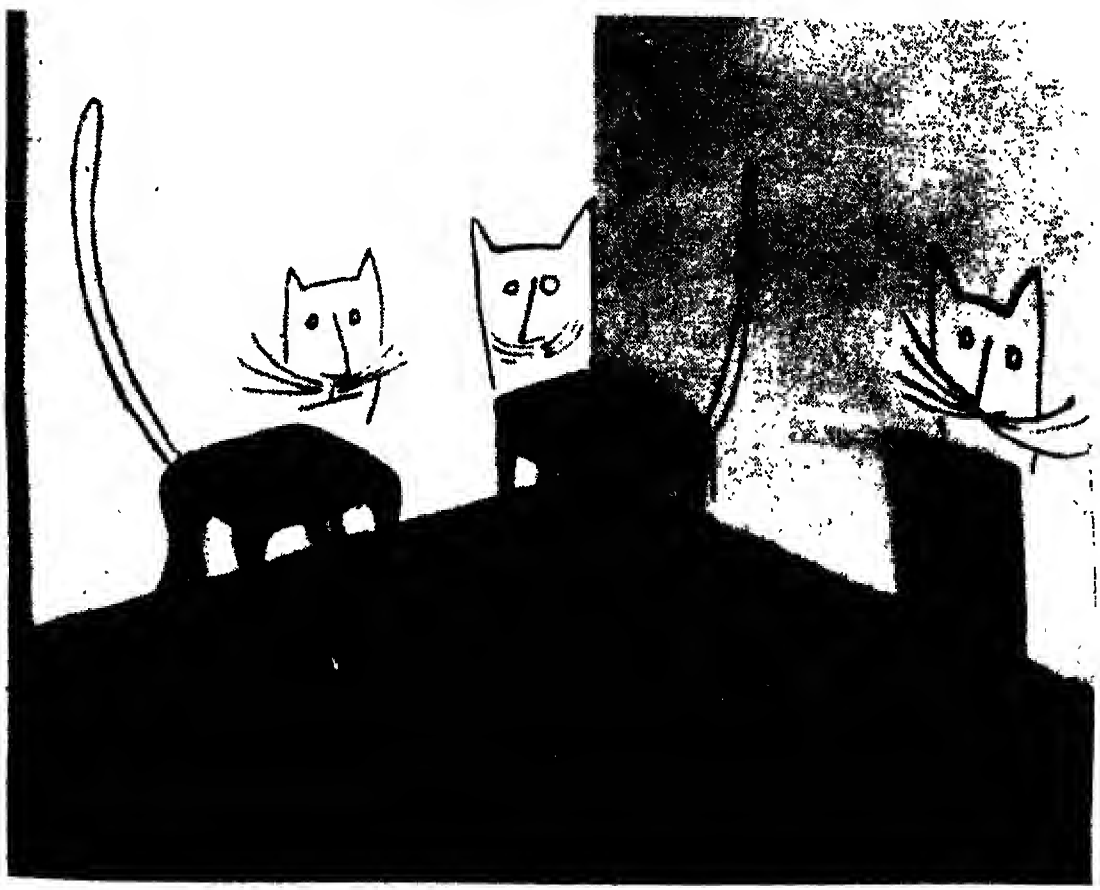

FIGURE 8. *Steinberg drawing showing how everyday objects can assume new meaning if controlled by an imaginative eye*

In the film world Orson Welles, for one, has proved how the imaginative vision of one can impart excitement and delight to the many if the performance is conceived and directed by a man of singular discrimination and vision. Steinberg, in the graphic field, has shown how the fresh eye can reveal new experiences in every-day things which are so common that normally one does not even notice them. By rediscovering them graphically he has made me and many others aware of countless phenomena which were so familiar that they had become almost meaningless. Studies of abstract patterns and sounds, as created by Norman McClaren, could show new ways altogether for use in television. One could imagine poetry especially written, and visually interpreted, for the new medium. The illustrations would be not so much an accompaniment of the more realistic and academic type, but complementary to the spoken word and literary image, creating an abstract world of symbols or a dreamlike, surrealistic atmosphere where visual images merge into each other as they often do, in fact, in the word-sequence of a poem.

Several films have been made featuring a single painting only. For instance, *The Feast of St. Isadore*, by Goya—a series of details in close-up, accompanied by Segovia's guitar—shows how a picture can come to life through the intelligent use of a new medium. The camera, with its talent for objective and selective concentration, was able to light up details of Goya's painting in a way impossible to the human unaided eye. In the same way television, if controlled by an imaginative eye, can raise the act of viewing from a time-killing habit to that of a living experience which will remain in the viewer's mind long after the receiver is switched off. Experience is nothing without retrospection; and the judging of television as an art form will depend, in the long run, on the power and permanence of its impact for good upon us all.

DISCUSSION

THE CHAIRMAN: The chairman is so fascinated by all that he has heard that he is incapable of containing his own remarks until comments of the audience have been made! So much has been said that is really stimulating and helpful. All those hard things the lecturer had to say about statistics go very close to my heart and all that he said about the horrors of television because it required so little effort (wherein of course it is fulfilling the whole concept of education in the last 25 years) that, too, seems to me extremely worth saying and most valuable. But in the end I suppose what was said most forcibly and at greatest length was an appeal to us to use television as a visual medium. There I have more reserves. In fact, what we see on a television screen is produced from life. We do not think of life as a visual experience, we think of it as a general experience. Sound broadcasting was the experience of a blind man, television is normal experience. The old silent film was a pure silent film—and I yield to none in my admiration of the fantasies of Melies—but even the old silent film finally found itself conquered by life. The fantasies, the tricks, the technical specialities of the medium, were gradually pushed aside because people are primarily interested in life and that, I think, is going to happen with television. We shall always be grateful for the people who think in visual terms and who enrich our visual sensations, but in the end what we look for in television is a reflection of experience. The trouble with a great deal of television now is we do not get it. What we do get is a miserable mauvish, woosy fantasy, and what I think all of us who are interested

in the future of television would like to see is more life. However, that is perhaps taking the subject too far because, although this may be the ultimate destiny of television, there is no doubt, I think, that this visual approach is going enormously to enrich the powers of the medium. A paper like this cannot be anything but most stimulating to all of those who are concerned with television.

MR. GEORGE HIM: I feel that television, like any other art, should not be life itself but sublimation of life, and if so, this ought to be produced by people with vision. That is where not the designer as a designer, but someone who can make more out of life by reshaping it in his own way, is the necessary person and surely most valuable. People who can create visions in visual terms should be welcomed.

THE CHAIRMAN: I am welcoming them.

MR. JOHN CRISFORD: Would Mr. Henrion agree that a trend is already apparent; that the cinema is concentrating more on fiction, and television more on fact? The cinema now is going in for spectacular dramas with tremendous success, which television can never do, while some of the most successful television programmes have been outside broadcasts, particularly from people's houses, as well as of sporting events.

THE LECTURER: I agree entirely, but it seems to me that there are not enough factual events to go round, because—again taking America as the example—there is an enormous amount of padding with films; because the facts being sports events, the occasional Coronation or its equivalent, there are not enough of them for 15 hours a day or, in American terms, several hundred hours a day, when all the various transmitting stations are considered. The problem is this constant finding of new material. I do not think there are enough facts to be found and you see and feel the embarrassment of the programme maker in padding all the time, to fill the void between the interesting programmes. There is no problem there. I hoped I made it clear that I think the outside broadcasts are first class, but that is not enough.

MR. W. M. DE MAJO, M.B.E.: Mr. Chairman, I am still rather perturbed at some of your closing sentences. I wonder whether you could reassure us and confirm that, what you said was in no way conflicting with what Mr. Henrion said in his paper to-day. If I may put it briefly, I understood you to say: give the public what it wants, give it not dramatized visual presentation but give it just real life. I understood Mr. Henrion to say that the man he was advocating, the professional designer, could do just this, but rather better by dramatizing simple everyday events.

I understood you to say that, while on the one hand you welcomed someone of Mr. Henrion's talents here to-day, you did not really think that this was what was wanted for television. It seems to me that someone with Mr. Henrion's qualifications could present everyday life in a much more interesting and exciting way than the rather dull and uninteresting manner we are shown on television to-day. Am I right in understanding the issue correctly?

THE CHAIRMAN: You are totally wrong in understanding what I said if you think I said that the public should be given what they want. The poor public will get what they want to a very large extent for economic reasons, but the whole art of anyone who deals with the public in matters of taste or entertainment is gradually to lead them to like things which are going to last them a little longer, or which they are going to enjoy a little more fully, or which are going to enhance their lives rather more. So in so far as you interpreted me to say that, it was a mistake. What I was saying about the films or about television is that in the end what people are interested in is life. By that I mean the story, the personality, the characters, the life content of anything that is shown. Although the element of fantasy and fantastic design and invention that Mr. Henrion talked about is extremely valuable and more refreshing, one must not get the idea that a new medium and a new technique are going to wipe out that basic need that we all have in all the arts for something that is concerned with human emotion and human experience.

MR. DE MAJO: This is what I understood you to say, although, of course, you have put it much better. But I still think what Mr. Henrion tried to explain was that a creative artist, if he were also the director-producer, could feature even the aspect of everyday life so much better. With his examples I understood him to explain only some possibilities of more interesting presentation technique, such as the three-in-one view of a picture instead of using the ordinary single-picture method; in other words, presenting a particular story more vividly and imaginatively for the screen than is done at present. I did not think that he was advocating that all stories were suitable to be presented in the same manner but tried to show just a few possibilities.

While I understand you to refer to his examples as 'fantasies' which would over-excite the story instead of giving it 'just life', Mr. Henrion surely said: Let us present 'just life' by all means; that is what we want to see, but let us present it more descriptively, putting the emphasis where it should be, with a bit more imagination, and more dramatically, than the la-di-da manner in which most television programmes are being dished up at present.

THE LECTURER: I think I agree entirely with Sir Kenneth as he explained the position. I should rectify an impression I seem to have left. I could not have made myself very clear, especially as the chairman seems to have got this false impression. I may have used as illustrations those gay French films, which are all very imaginative and fantastic, but what I tried to explain—apparently not very successfully—is that television, in reporting life, reports it very subjectively through the producer's eye. I do not think there is any such thing as objective reporting. Whatever is seen on the screen is shown from one person's angle or several person's angle. Very much depends on how news is presented. In the presentation of that I feel that a visually experienced imaginative man might convey a more true picture of what is happening than a mere reporter and technician. If the men behind the television camera had the same

enthusiasm for and preoccupation with their medium as the early French film pioneers, our programmes would be much more alive and inspiring than they have been hitherto.

THE CHAIRMAN: I think we were perhaps a little misled by the emphasis given to the early films. It is quite true that when the early film makers started they were fascinated by what could be done with that medium in the way of fantasy—the people who built the walls by throwing bricks over their shoulders, and so forth. All those things were very agreeable and they lasted for a time, as the new technical developments of any new medium do, but in the end such novelties are absorbed and we come back to the same things that have interested human beings for 2,500 years.

MR. HOWARD WADMAN: Should I be right in thinking that what we need is a blend of the visual and the humane? There is a famous film passage which is often quoted—'The Odessa Steps' sequence. Many people are fond of looking at this sequence and are perhaps dazzled and intoxicated by the pattern of the steps; but is not the real interest of that scene the fact that a lot of people may be shot dead by the forces of reaction? Is that not really what is holding one's interest in the steps? It seems to me that a visual man who is only a visual man may go away from such a scene intoxicated by the pattern of the steps and forgetting what the public was really interested in. It is the two things blended together that make great cinema, and presumably will make great television. This surely is why the theatre is greater than the circus. At the circus one may see stunt cycling, which is very remarkable, but it may be much more wonderful to go to the theatre and see a man sitting quietly in a chair and talking about the way life is lived and death is died.

THE LECTURER: The title is *Potemkin* I think, by Eisenstein. I agree entirely with you, of course. If I made the case for the visual man very strongly, of course it must not be one sided. Perhaps in my enthusiasm I stressed the visual side too much. If I did that it was only because it is usually not in my view sufficiently considered. The steps alone are of no interest, but making the steps do a job in connection with the screaming women and children was certainly the success of the film.

THE CHAIRMAN: We really owe Mr. Henrion a very great debt, because he has treated television as an art. It is the nature of art that the means of communication and the technical inner character of the medium enhance and give a durability to the human content which must underlie all art and that, in fact, is what he has been telling us about the application of art in television. Thank you very much.

A vote of thanks to the Lecturer was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

GENERAL NOTES

CHILDREN'S PAINTINGS AND DRAWINGS

The 61st annual exhibition of the Royal Drawing Society, the pioneer of exhibitions of children's art, will be on view at the Guildhall Art Gallery, London, from 28th April to 12th May. The pictures were selected from entries received from schools in this country and the Commonwealth, the entrants being aged from four to 17 years. Also, this year the exhibition includes a series of pictures by children of five and six years of age which have been collected from Paris kindergartens and lent to the Royal Drawing Society by the French Embassy. The exhibition will be open on weekdays from 10 a.m. to 5 p.m.; admission will be free.

TRANSPORT RESEARCH GRANT

Applications are invited for the two Rees Jeffrys Studentships offered this year. These are tenable at the London School of Economics and will enable the holders

to devote at least one whole year to full-time research into the economics of transport. The Studentships are open to any person who is or has been engaged in the administration of transport or in the production of transport equipment or facilities, and to university graduates. The Studentship, each of which will be of the value of £500, will be tenable from 1st October, 1956, for one year. Full particulars and application forms, which must be returned not later than 1st September, 1956, can be obtained from the Registrar, London School of Economics, London, W.C.2.

CORRESPONDENCE

IMPERIAL INSTITUTE

From MR. MARTIN A. BUCKMASTER, A.R.C.A., HON.A R I B.A., 9 COLEHERNE MANSIONS, 230 OLD BROMPTON ROAD, S.W.5

I am glad to see by this month's *Journal* that the Royal Society of Arts is doing its utmost to save the Imperial Institute from demolition.

I likewise was a modest subscriber to the building, attended the opening ceremony by King Edward VII and the banquet following, joined the Imperial Institute Club and also worked in the building as an Examiner to the London University. Its destruction would be a wanton act of vandalism when one knows the type of building that might replace it. I have written several letters to the press and to Members of Parliament. Please continue your good work.

NOTES ON BOOKS

DECORATED PORCELAINS OF SIMON LISSIM. *By Raymond Lister. Golden Head Press,* 1955. 31*s* 6*d*

Simon Lissim is a cosmopolitan. Born in Kiev in 1900 his education started in Russia, which he left in 1919, and presumably continued during his European travels. He settled in Paris until 1940 and after demobilization went to the United States, where he is now Associate Professor of Art at the City College of New York.

Lissim is clearly that *rara avis*—a successful ceramic designer who is also an all-rounder; indeed he seems to be better known for his stage designs than for his porcelains. One wishes that Mr. Lister's book showed us more of his other work, for the reader is tantalized by frequent references to it; one wonders what parallels there were in his stage sets to those extraordinary beasts and fish—of such oriental features—which decorate many of his porcelains. Was this refreshing combination of formality and spatial freedom to be seen in the paintings so often shown in Paris?

The Golden Head Press has produced a limited edition whose cover, paper and typography do justice to the subject, but I would gladly have sacrificed the beautiful blue and gold cover for one or two good colour plates inside. The ceramic artist wrestles with special colour problems. Only certain colours will withstand the rigours of firing. Some will go under the glaze, some only on top. Some need several firings to bring out their richness. These are factors which have to be reckoned with those of shape and body. No words, even combined with black and white plates, can really convey to us how effectively Lissim dealt with these difficulties.

Of his 500 designs, most were for single pieces and only about thirty imposed the disciplines and limitations of adaptation to the many shapes (anything up to fifty) required for a full range of tableware and unfortunately none of these is illustrated. But the plates show a catholicity of design curiously in step with their period: Lissim is a *virtuoso* rather than *avant garde*. The gorgeous 'large platter' in gold, red, white and black, made in 1928, is clearly a beautiful, rich and formal piece contrasting strangely with another platter decorated with not very beautiful fish rather painfully

squeezed into the shape of the dish. The coffee cup and saucer combine superb shapes with a geometrical design related, no doubt, to the rather self-conscious cubist pipes but so well matured as to be timeless in quality. So also the cigarette holders; the Russian influence is strong here but the designs and shapes have an individual strength that is as acceptable now—and neither more nor less 'modern'—as when the pieces were designed 18 years ago.

On the other hand some of the vases seem to be pure 1920 to 1930 stuff and if they have merit in terms of shape or design the illustrations do them less than justice. By contrast there is a plate in gold and dark brown on white that holds great excitement. It is roughly circular with an eliptical rim and a free yet formal design. This is the most original piece in the book but we are not told how the pattern is applied.

Most of the pieces shown are flat wear, but there are one or two interesting holloware examples including a bowl whose delightfully clean and sweeping shape seems to sacrifice some of its pleasure to the uneven line in the decoration just below the rim. But in shapes and decoration alike Lissim has eschewed any tendency towards bogus 'contemporaryism'. Fashions, as well as much more profound things, have had their influence but every attempt has the hallmark of honesty; one has the feeling that if Simon Lissim walked up any road that appealed to him he would *arrive*, come what may, or if the road did not after all lead anywhere, he would come back undaunted. But he is no meanderer.

ALAN EDEN-GREEN

SHORT NOTES ON OTHER BOOKS

CURSIVE HANDWRITING. *By Philip A. Burgoyne. Dryad Press*, 1955. 9*s* 6*d*

Cursive Handwriting presents to teachers and senior students an approach to handwriting as a craft. There are examples of how writing and drawing can be used together in the making of manuscript pages. Two charts illustrate the pedigree of writing and the treatment of illustrations, and there are examples of individual letters and of page arrangement.

THE CHARM OF INDO-ISLAMIC ARCHITECTURE. *By John Terry. Tiranti*, 1955. 15*s*

A period of 600 years, from the thirteenth to the early nineteenth century, is covered by the development of Islamic architecture in India. Much of this time was taken up by the difficulty of achieving a synthesis between the ideas of the Muslim patron, and the Hindu building craftsman, whose hereditary occupation was carried out on lines often diametrically opposed to Islamic theories of building. The book contains 61 photographic plates.

A CONCISE DICTIONARY OF ENGLISH SLANG. *By William Freeman. English Universities Press*, 1956. 8*s* 6*d*

Everyday phrases and idioms are here collected and briefly explained. The origin is stated, where possible, and an example supplied, though the scope of the book permits of only an indication of the various divisions into which slang falls.

FROM THE JOURNAL OF 1856

VOLUME IV. 25*th April*, 1856

PROCEEDINGS OF INSTITUTIONS

SALFORD.—On Friday evening, the 11th inst., the pupils of the Mechanics' Institution Day and Evening Schools were publicly examined, and a distribution of prizes took place, for which the necessary funds had been provided by Mr. E. R.

Langworthy, the president, who occupied the chair on this occasion. On the platform with him were Mr. D. Chadwick, the treasurer, and Mr. Urquhart, the hon. sec. There were also on the platform about 70 boys, and between 20 and 30 girls, the subjects for examination. They were selected from the day schools, in which there are 100 boys and 30 girls, and from the evening classes, which are thus attended: Writing, 73; arithmetic, 74; grammar, 67; drawing, 6; French, 6; mathematics, 8; singing, 6; writing, &c. (female), 25. Mr. John Angell, the master of the boys' school, commenced the examination with a lesson on social economy, in which each question and answer formed a distinct logical step in the chain of reasoning proving a given proposition. The girls were then examined in geography and grammar, by their teacher, Miss Agnes Miller, and in arithmetic, by Mr. Chadwick. Mr. Angell further examined his boys in fractional arithmetic and grammatical analysis; and the examination concluded with a lesson on human physiology, conducted by means of a human skeleton and diagrams. The examination throughout was most satisfactory, and the intelligence and readiness of the replies elicited much approbation. The prizes were then distributed to the more deserving pupils, of whom the following is a list: Day Schools—John Corns, William Bogg, Thomas Rowlands, James Ashton, Francis Henstock, George E. Tunnecliffe; Miss Tickell, Miss E. Gilman, and Miss Brassington. Evening Classes—Grammar, John Roberts; George Teasdale; drawing, James Hamer and Alexander Braid; arithmetic, James Shephard and William Parker; writing, Richard Hulme and Thomas Foster; music, John Royle; female class, Miss Bell, Miss E. Robinson, and Miss F. Gill. A vote of thanks to the president terminated the proceedings. The directors, it is understood, entertain hopes of some of the pupils competing at the Society of Arts' examinations in June next; and are, it is said, prepared to contribute towards the expenses of deserving candidates.

Some Activities of Other Societies and Organizations

MEETINGS

MON 30 APR Geographical Society, Royal, South Kensington, S.W.7 8.30 p.m. Sir Gavin de Beer *Alps and Elephants*

TUES 1 MAY Electrical Engineers, Institution of, Savoy Place, W.C.2 5.30 p.m. *Methods of Fault Detection and Location in Impulse Tests on Transformers* (Discussion)

Incorporated Plant Engineers, at the Royal Society of Arts, W.C.2 7 p.m. N Tinwell *Repairs of Cracked Castings the Modern Methods*

Japan Society of London, at the Victoria & Albert Museum, South Kensington, S.W.7 5.30 p.m. Ko Miyake *Japan - Tradition and Transformation*

Manchester Geographical Society, 16 St Mary's Parsonage, Manchester, 3 6.30 p.m. T Burton Brown *Recent Visit to Turkey*

WED 2 MAY Engineers, Junior Institution of, at the James Watt Memorial Institute, Great Charles Street, Birmingham 7 p.m. John A Sargrove *Electronic Control the New Power in Industry*

THURS 3 MAY Anthropological Institute, Royal, 21 Bedford Square, W.C.1 5.30 p.m. R E Bradbury: *Ugie-Oro . a Cult Festival in a Benin Village*

Refrigeration, Institute of, at the Institution of Mechanical Engineers, 1 Birdcage Walk, S.W.1 5.30 p.m. D B Smith: *The use of Radioactive Techniques in Refrigeration Engineering.*

FRI 4 MAY. Mechanical Engineers, Institution of, 1 Birdcage Walk, S.W.1. 5.30 p.m. (1) S P. Hutton *Three Dimensional Motion in Axial Flow Impellers.* (2) F A Spencer: *The Performance of an Axial Flow Pump.*

MON. 7 MAY. Engineers, Society of, at the Geological Society, Burlington House, Piccadilly, W.1. 5.30 p.m. D F Brice *Oil fired Packaged Portable Boilers*

TUES 8 MAY Electrical Engineers, Institution of, Savoy Place, W.C.2 5.30 p.m. J Bell *Ship Stabilization. Automatic Controls, Computed and in Practice*

WED 9 MAY Electrical Engineers, Institution of, Savoy Place, W.C.2 5.30 p.m. L. R. F Harris *Time Sharing as a Basis for Electronic Telephone Switching 4 Switched Highways System*

FRI 11 MAY Mechanical Engineers, Institution of, 1 Birdcage Walk, S.W.1 5.30 p.m. R R Whyte *The Influence of the Gas Turbine Axial Flow Aero Engine on Blade Manufacturing Methods*

OTHER ACTIVITIES

MON 30 APR UNTIL SUN 6 MAY Imperial Institute, South Kensington, S.W.7 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays Films *Oil in Pakistan; Rhodesia Spotlight No 30: Flying Surveyor—Canada*

MON 7 MAY UNTIL SUN 13 MAY Imperial Institute, South Kensington, S.W.7 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays Films: *Bhopal—India. Land of Zinj—East Africa.*

NOW UNTIL 18 MAY. Wood Engravers, Society of, at The Crafts Centre of Great Britain, 16-17 Hay Hill, W.1 *Exhibition of Wood Engravings and Colour Prints.*

NOW UNTIL 26 MAY Contemporary Arts, Institute of, 17-18 Dover Street, W.1 Exhibition: *Roberto Burle Marx: Brazilian Landscape and Garden Design*

NOW UNTIL 30 MAY Imperial Institute, South Kensington, S.W.7 Exhibition of Current Issues. *Commonwealth Postage Stamps*

THE ROYAL SOCIETY OF ARTS

JOHN ADAM STREET ADELPHI LONDON W.C.2

FOUNDED IN 1754 AND INCORPORATED BY ROYAL CHARTER IN 1847

PATRON : HER MAJESTY THE QUEEN

PRESIDENT : HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH, K.G.

PROPOSAL FORM FOR MEMBERSHIP

Candidate's Name in full

Nationality

Address

Rank, Profession or Business

I desire to become a Fellow/an Associate Member of the Royal Society of Arts.

Signature of Candidate

Date of Birth

We hereby propose and recommend the above Candidate as a fit and proper person to become a Fellow/an Associate Member of the Royal Society for the Encouragement of Arts, Manufactures and Commerce.

Signatures of three Fellows, at least one of whom must sign on personal knowledge :

Name in Block Capitals	Signature
[ ]	*(on personal knowledge)*
[ ]	
[ ]	

Details of Candidate's academic and professional qualifications (when a University Degree is quoted the name of the University conferring it should be stated), past and present occupation, and any other relevant information :

FELLOWSHIP

Fellowship of the Royal Society of Arts is open to suitable persons over 21 years of age. Candidates for election must be proposed and seconded by three Fellows, one of whom, at least, must know the applicant personally. Fellows are entitled to the following privileges :

To attend Meetings of the Society, and to introduce two visitors at such Meetings.

To receive the Society's *Journal*.

To use the Society's Reference and Lending Library.

ASSOCIATE MEMBERSHIP

Persons who have attained the age of 18 and are under 21 years of age can be admitted as Associates only. On reaching the age of 21 they may decide either to remain Associates until they reach the age of 25, or to apply for Fellowship. They may not remain Associates after reaching the age of 25.

Associates are entitled to all the privileges mentioned above, except that they are not permitted to use any designating letters or to style themselves 'Associate of the Royal Society of Arts'.

The procedure for election as an Associate is the same as that for election as a Fellow.

SUBSCRIPTION

For Fellows : £4 4s. 0d. per annum, or a life composition fee of £42 0s. 0d. There is a registration fee, in addition, of £2 2s. 0d.

For Associates : £1 1s. 0d. per annum. (No registration fee.)

Subscriptions date from the quarter day preceding election. No payment should be made until after election.

THE ROYAL SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES AND COMMERCE

PATRON: HER MAJESTY THE QUEEN

COUNCIL

Full particulars relating to the work of the Society and conditions of membership and associate membership may be obtained from the Secretary.

The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

All other communications for the Society should be addressed to THE SECRETARY, ROYAL SOCIETY OF ARTS, 6–8 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2. Telephone number: Trafalgar 2366. Telegrams: Praxiteles, Rand, London.

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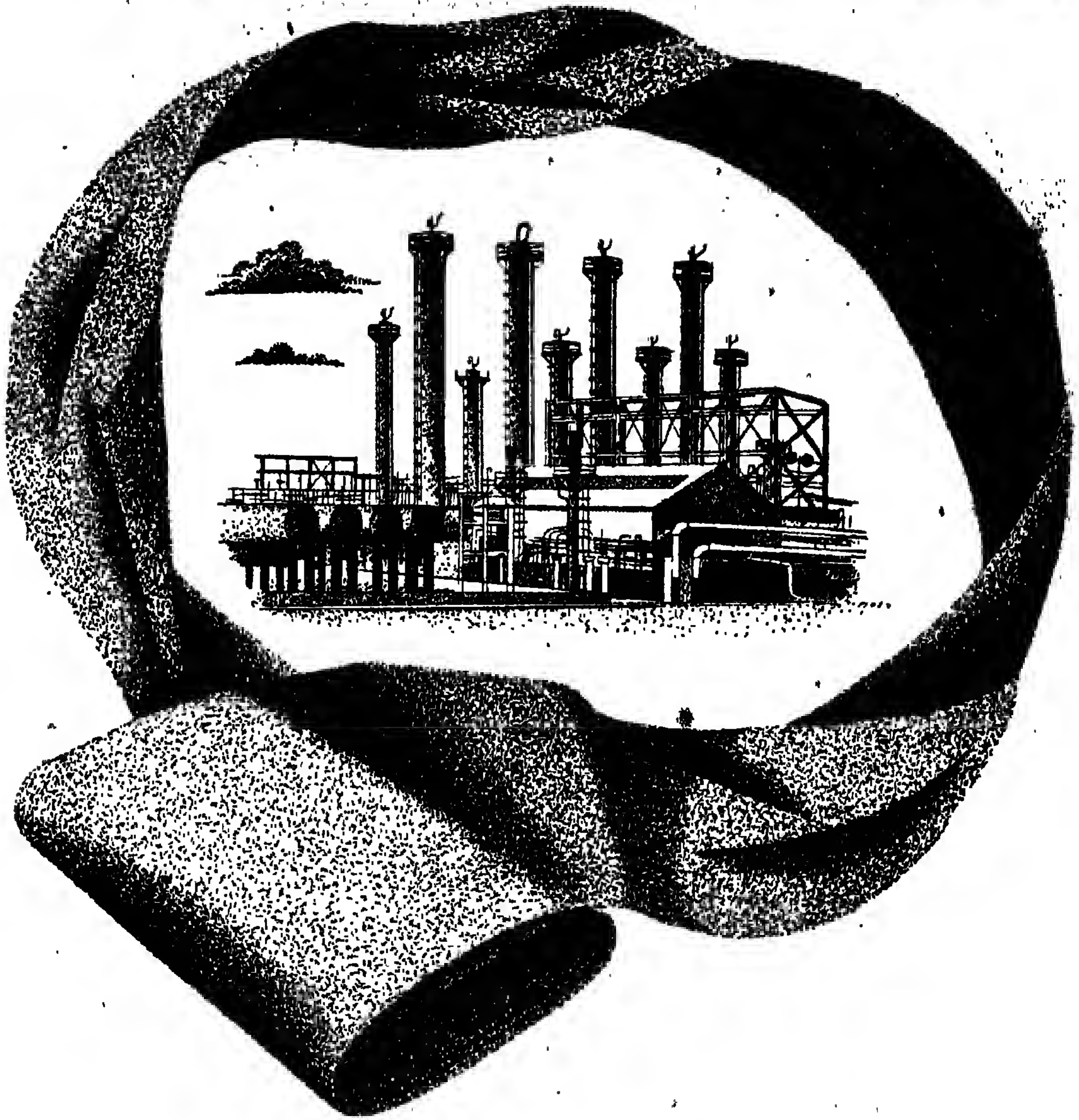
LONDON

THE ROYAL SOCIETY OF ARTS, JOHN ADAM STREET, ADELPHI, W.C.2

PRICE TWO SHILLINGS AND SIXPENCE



Journal of the Royal Society of Arts

NO. 4977 FRIDAY, 11TH MAY, 1956 VOL CIV

FORTHCOMING MEETINGS

MONDAY, 14TH MAY, at 6 p.m. The second of three CANTOR LECTURES on '*Some Recent Studies of Sociology*', entitled '*Some Aspects of the Development of Demography*', by David V. Glass, B.Sc.(Econ.), Ph.D., Professor of Sociology, University of London at the London School of Economics.

WEDNESDAY, 16TH MAY, at 2.30 p.m. PETER LE NEVE FOSTER LECTURE. '*Electronic Photography*', by C. G. Mayer, O.B.E., M.I.E.E., of the Radio Corporation of America. Sir Harold Bishop, C.B.E., F.C.G.I., M.I.E.E., M.I.Mech.E., Director of Technical Services, British Broadcasting Corporation, will preside. (The lecture will be illustrated with demonstrations and lantern slides.)

MONDAY, 28TH MAY, at 6 p.m. The last of three CANTOR LECTURES on '*Some Recent Studies of Sociology*', entitled '*Changes in Social Responsibilities*', by Roger F. Tredgold, M.A., M.D.

TUESDAY, 29TH MAY, at 5.15 p.m. COMMONWEALTH SECTION. NEIL MATHESON MCWHARRIE LECTURE. '*The Theatre and Ballet in Canada*', by Robert Speaight, M.A., F.R.S.L. His Excellency Mr. Norman A. Robertson, High Commissioner for Canada, will preside. (Tea will be served from 4.30 p.m.)

WEDNESDAY, 30TH MAY, at 2.30 p.m. '*Examinations : Do We Still Need Them?*' by Sir Griffith Williams, K.B.E., C.B., a Member of the Council of the Society, and former Deputy Secretary, Ministry of Education. Sir Edward Crowe, K.C.M.G., a Vice-President of the Society and Chairman of its Examinations Committee, will preside.

WEDNESDAY, 6TH JUNE, at 2.30 p.m. '*The Influence of National Character on Design*', by Paul Reilly, Deputy Director, Council of Industrial Design. John Gloag, Hon.A.R.I.B.A., a Member of Council of the Society, will preside. (The paper will be illustrated with lantern slides.)

Fellows are entitled to attend any of the Society's meetings without tickets (except where otherwise stated), and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

INDUSTRIAL ART BURSARIES EXHIBITION

The Exhibition of winning and commended designs submitted in the 1955 Industrial Art Bursaries Competition was opened in the Library by the Right Honble. Sir David Eccles, K.C.V.O., M.P., Minister of Education, on Wednesday, 2nd May.

There was a large audience which consisted of those directly concerned with the work of the Competition and included a number of Principals of Schools and members of the industries which subscribed towards the awards.

SIR ERNEST GOODALE, the Chairman of the Industrial Art Bursaries Board, and a Vice-President of the Society, in introducing the Minister, pointed out that the Competition, which was revived after the war, was now firmly established. Referring to the objects of the Competition, as set out in the Report, Sir Ernest spoke of the Council's hope that the broader purpose of encouraging students to turn to industrial designing for a career, rather than to art teaching, would also be fostered. In this way the Society's early awards of premiums in different branches of commerce were carried on.

In thanking the various individuals and bodies who supported the Competition financially, and those eminent ladies and gentlemen who had so generously given their time on the Juries, Sir Ernest referred to the fact that the latter looked for signs of promise rather than of present accomplishment, although the method of presentation had much improved over the years. The reports on their tours submitted by the students, several of which were on display, were frequently most competently presented and illustrated. The interest shown in the Exhibition, which was this year to be shown not only in some provincial cities but also at The Production Exhibition at Olympia, was noteworthy.

Referring to the new sections to be included in the 1956 Competition, Sir Ernest welcomed the return of those for domestic glassware and pottery, and the introduction of a new section for the design of cinema and television settings. He also mentioned that additional Bursaries were being offered, thanks to the generosity of Sir Herman Lebus and Mr. George Minter.

In conclusion, Sir Ernest spoke of the Society's gratitude for the interest shown in the Competition by the Ministry of Education, which was clearly indicated by the Minister himself having graciously consented to open the Exhibition, and this Sir Ernest then invited him to do.

THE MINISTER said:

It is very kind of the Royal Society of Arts to give me the chance to come and congratulate them on this new round of their Competition. I have always been intensely interested in design. I had a chance at the Ministry of Works to do something on a practical scale and nobody helped us more than Sir Ernest Goodale himself. I can assure you that many times in the preparations for the Coronation, when we rushed off to get him and said 'well, what about it', he was always there with his advice, which was so helpful, and I think with such a fine taste in everything.

I really come from the agricultural industry which is the wisest, the oldest industry in the country. We have certainly had shows for cattle and pigs and

sheep from time immemorial. It is very good for the animals and it is very good for the farmers. I think that it is the same with this sort of show—it is very good for the designers and for the industrialists, and I hope that the idea will spread. I was very interested to hear the chairman say that the industrialists put up by far the larger part of the money. That is good, and it does show that business men, who are always supposed to look for results, think it is worth while risking their shareholders' money—it is not theirs, of course, it is their shareholders'—in these prizes. This must be of great satisfaction to Sir Gordon Russell who sometimes laments a little, I think, at the slow way business takes up design. Anyway, he can feel—I see him there—that here is one small proof that they are waking up.

You said, Mr. Chairman, that you thought that it was a good thing for students to go off into industry and for not too many of them to teach. I agree with that up to a point, but what I really wish to see is a two-way street between industry and teaching. I think we have invented a thing called the 'sandwich course', which means that the student goes for six months to a technical college and then for six months to industry, and so on perhaps for four or five years—six months in each. What I must find is some 'sandwich' professors! Industry must help me. I want the people who teach to have a closer contact with the manufacturer and industry generally. Industry has been generous in lending us teachers, but perhaps we can go a little bit further. I am not at all sure that that sort of life does not rather suit the British people, being partly academic and partly practical. Anyway I am going to pursue this plan and I hope you will help me.

From time to time some branch of industry comes to the Ministry and asks whether they can run a design competition of their own. Well, of course, far better a competition on their own than none at all. We all agree about that, but I think it would be better still if they would come in under the umbrella of the Royal Society of Arts, because I think a collection of exhibits, of works of art at any rate, has a value beyond that of the individual exhibits. This is particularly true when the artists are not well known. If you can get a show going together with others, then it enables you to exchange ideas and to make new contacts. On the whole therefore, I would say to industries who are thinking about setting up competitions, first of all, at any rate, give thought to joining the list of Bursaries here.

I was glad to see that there are some more on your list this year and especially that the women's fashions have flourished. It must be a great source of pleasure to have the Bianca Mosca scholarships inside this scheme. I have to admit that when I was younger and richer I often went to a dress show. I do not think there is any pleasure in the world equal to buying a dress for someone who, at any rate for the first time, will wear it in your company. Those are old days which I have almost forgotten.

I would like to join with Sir Ernest and thank all the Juries—they have evidently taken very great trouble and those short reports which are printed in the Report seem to me to be of great value and interest both to the visitors who come to look and, I should also say, to the students themselves. We want cross fertilization between one type of designer and another. I looked at the names of the members of the Juries and saw that there were some friends of mine there—Sir Francis Meynell, for example. I saw him in a new *rôle* for I know that he is a master at printing a book, but he seems to be an expert at poking the fire as well! Anyhow he takes everything in his stride and I am sure that he is very typical of the quality of the Juries. I think that a Royal Designer for Industry is to be found on every one. That is a wonderful thing that the Royal Society of Arts did in starting the Faculty of Royal Designers for

Industry—it must have raised the status of the designer a great deal. It made a lot of people conscious of design who, perhaps, had not thought of it before.

It only remains to me to congratulate the winners. I hope they will have a good trip abroad if they go. I think it is Mr. Jacobs who looks after the arrangements for these trips—they are very well arranged. I have had just a little look at one or two of the reports here—they ought to go, I suppose, to the British Museum as social documents. They look splendid. I am sorry for those who are runners-up. It is rather bad luck if you are so near the money and not quite there, but they will, perhaps, have better luck next time. I hope they will go in again, if that is allowed by the rules of the Competition.

I think we have to be publicity agents for designing; we have all got to shout it out from the roof-tops. I was particularly interested when we were talking to the Russians the other day. You will notice that almost the last sentence of the *communiqué* after the Russian visit broke new ground; it said that the Russians were interested in the import of consumer goods. That is new ground, and highly significant. What exactly they meant I do not know, but I hope they meant dresses for their girls, and I have a suspicion that would be a pretty good market. Anyway the point is we are going to be able to break into this great new market behind the Iron Curtain with a trickle, at any rate, of consumer goods. We cannot tell what this might mean: certainly our designs will carry there a message of great importance. Let us all keep up the cry for good designing. The walls of Birmingham or Jericho—or wherever it is—are falling down—and you are getting in.

I therefore have the greatest pleasure in opening this Exhibition.

DR. R. W. HOLLAND (Chairman of the Council of the Society) in thanking the Minister pointed out how appropriate it was that the Minister of Education should open the Exhibition. What was more, he had as Minister of Works been responsible for the Coronation arrangements and had also been for a time during the war at the Ministry of Production, the connection between design and production being self evident. In concluding, Dr. Holland expressed the Society's great appreciation of the kindness of a busy Minister in opening the Exhibition, and of the confirmation which this provided of the importance of its subject.

After the opening of the Exhibition, Sir David Eccles was entertained at luncheon at the Savoy Hotel by members of the Council of the Society.

As already announced, the Exhibition will remain open at the Society's House until Friday, 18th May: from 10 a.m. to 5.30 p.m. on Mondays to Fridays, and from 10 a.m. to 12.30 p.m. on Saturdays.

PUBLICATION OF 1955 COMPETITION REPORT

The Report on the 1955 Industrial Art Bursaries Competition has now been published, and copies may be obtained from the Deputy Secretary without charge.

In addition to the list of awards, which was published in the *Journal* on 2nd March last, the Report also contains particulars of the Tests set in each section, the reports and compositions of the Juries, and a summary of the uses made of Bursaries in 1955 by previous Bursary winners. Illustrations of most

of the winning designs, a number of which were reproduced in the *Journal* on 2nd March last, are also included in the Report.

INDUSTRIAL ART BURSARIES COMPETITION, 1956

The Report on the 1955 Competition referred to above contains the particulars of the Competition to be held in 1956. The following sections will be included and, except where otherwise stated, one Bursary of £150 will be offered in each:

DOMESTIC ELECTRICAL APPLIANCES
ELECTRIC LIGHT FITTINGS
DOMESTIC SOLID-FUEL-BURNING APPLIANCES
CARPETS
DRESS TEXTILES (TWO BURSARIES)
FURNISHING TEXTILES
WOMEN'S FASHION WEAR (TWO BIANCA MOSCA AWARDS OF £200 AND £150 RESPECTIVELY)
ACRYLIC SHEET ('PERSPEX')
LAMINATED PLASTICS
P.V.C. PLASTICS SHEETING
CINEMA AND TELEVISION SETTINGS
DOMESTIC GLASSWARE
FOOTWEAR
FURNITURE (THREE BURSARIES)
JEWELLERY
POTTERY
WALL-PAPER

In addition to the above Bursaries the Council of the Society may provide supplementary awards from the Art Congress Studentship Trust Fund and from the Owen Jones Memorial Trust Fund.

Subject to certain conditions, successful candidates will be offered Associate Membership of the Society.

The Sir Frank Warner Memorial Medal will be awarded to the candidate submitting the best design in the Set Test in either the Furnishing Textiles, Dress Textiles, or Carpet sections of the Competition, if of sufficient merit. This Medal may be awarded to a successful candidate in addition to a Bursary.

The last day for the receipt of entry forms is 15th October, 1956.

THE SOCIETY'S CHRISTMAS CARD, 1956

With the object of providing as long notice as possible to overseas Fellows, so that they may be able to place their orders in good time, this preliminary announcement is given of the card which the Society will produce for the use of its Fellows for Christmas 1956.

In view of the recent celebrations of the 250th Anniversary of the birth of Benjamin Franklin and the approaching Bicentenary of his election to membership of the Society of Arts on 1st September, 1756, it seemed appropriate that the card should this year celebrate the association of Franklin with the Society. The subject which has been chosen is his attendance at a meeting, on 3rd February, 1759, of the Committee responsible for the adjudication of the

entries for the Society's art competitions. The records of this meeting are complete to the extent not only of giving the names of the members of the Society who assisted with the judging, but also the names of the candidates who were interviewed and, in a number of cases, the actual drawings.

The Society is fortunate in again having persuaded Miss Anna Zinkeisen, R.O.I., R.D.I., to reconstruct the scene and her painting will be reproduced in full colour.

An illustration of the Christmas card will be published in the *Journal* in due course, and in the meantime it would be of assistance if Fellows resident in places abroad to which surface mails from this country are slow, would indicate their requirements to the Secretary. Owing to increased printing costs it is expected that the charges will be slightly, but not much, higher than last year, when they were 11*s.* 6*d.* a dozen for overseas members and 14*s.* a dozen for home members. Overprinting of the name and address can be undertaken at an extra charge. Full details of prices will be announced as soon as possible, and it is hoped that the cards themselves will be ready for despatch by the end of September.

INSTITUTIONS IN UNION

Under the Society's Bye-Laws the Council may admit into union any body or organization whose objects are similar to those of the Society, namely, the encouragement of arts, manufactures or commerce. This wide definition embraces literary and scientific institutions, libraries, universities, schools, colleges and the like, and it is the Council's desire that the number of these Institutions in Union should be increased. The privileges attaching thereto are much the same as those of individual Fellowship, and include, for an annual subscription of £3 3*s.* 0*d.*, the receipt of the fortnightly *Journal* and the right of an appointed representative to use the library and to attend meetings.

It is possible that many Fellows may be connected with, or be aware of, eligible organizations which might benefit as a result of associating with the Society in this way, and fuller details of the scheme will gladly be sent on request either to Fellows or direct to bodies suggested.

THE ARITHMETIC OF THE MUSICAL SCALE

A paper by

L. H. BEDFORD, O.B.E., M.A., B.Sc., M.I.E.E., of the English Electric Co., Ltd., *read to the Society on Wednesday, 15th February, 1956, with W. Greenhouse Allt, Mus.D., Principal, Trinity College of Music, and a Member of Council of the Society, in the Chair*

THE CHAIRMAN: The title of this paper interests me as a musician, but arithmetic always daunts me. However, I know Mr. Bedford to be one of those rare birds, a highly skilled physicist who is also a musician; a musician because he loves music and is surrounded by a music family. His father, mother, and grandmother, his wife and his three children are all musicians, which should be enough to lift him from the solid earth of physics into the realm of music.

If these are controversial matters in his paper it may be unwise to cross swords with him in argument, because in everyday life he is a Chief Engineer of Guided Weapons!

The following paper, which was illustrated with musical and physical demonstrations, was then read:

THE PAPER

INTRODUCTION

About the year 500 B.C., Pythagoras gave a clear arithmetical basis to the musical scale. In 1885 Ellis and Hipkin[1] were able to collect and tabulate on a numerical basis some 130 musical scales from all sources. From 1850 onwards the Even Tempered scale for keyed instruments gained ascendancy over all previous temperaments, a situation which has become so far consolidated that scarcely any living person has had the opportunity of hearing anything else. In these circumstances, it may well be asked what more remains to be said and what justification exists for a paper of the present title? To this highly reasonable question, one may offer the following answers:

First the universal adoption of Even Temper has not only thrown into oblivion the beautiful arithmetical patterns which underlie the earlier temperaments but has also brought about the situation that such temperaments can never be heard. The present paper, with its essential component of musical demonstrations, endeavours to correct this situation.

More importantly, however, a new issue comes up for consideration arising from the interesting impact of a new subject on one some hundred times its age, that of electronics on music. With the introduction of electronic musical instruments, especially the electronic organ, still in its infancy (and of suspected illegitimacy), we are for the first time in history unfettered from the restriction

of a fixed temperament. The implications of this remain to be assessed, but should imply a revival of interest in the subject of scales and temperaments.

PHYSICO—MUSICAL PREAMBLE

In approaching a subject which is essentially common ground to the musician and the physicist, one is faced with the problem that they lack any commonality of language and even of ideas. It is, therefore, the purpose of this introduction to present some common approach, and the writer believes that this must be framed largely in the language of physics. Therefore, at the risk of banality, one must commence with the statement that 'sound' is essentially an oscillatory fluctuation of air pressure for which the ear and brain provide an incredibly elaborate receptor and interpretive mechanism. As a special category of sound, one may classify as 'musical' those sounds which are essentially cyclic in character, that is the pressure fluctuation repeats at regular time intervals. The number of complete cycles occurring per second is called the *frequency*.

For analytical purposes one particularly important form of oscillation focusses attention, that of the simplest form of ocsillatory system comprising one stiffness and one inertia, for example a mass on the end of a spring; this oscillation is termed sinusoidal. More complex sounds can be expressed as a combination of sinusoids, and in musical tones the frequencies of these are integrally related. This corresponds with the fact that musical vibrators such as strings and pipes have oscillatory modes thus integrally related in frequency; whereas in non-musical sounds (gongs, drums, and so on) the frequency ratios are definite but not integral.

From a musical point of view, the most important characteristic of a tone is its pitch, and this is found to be associated very directly with its frequency, namely the number of cycles (of pressure fluctuation) per second. The question immediately arises with what range of frequencies and with what amplitudes of pressure fluctuation are we concerned? This is answered somewhat comprehensively by the diagram of Figure 1, which indicates primarily the characteristics of the human ear. Because of the wide spread of hearing characteristics between individuals, a statistical presentation is adopted[2]. The lower three curves are minimum audibility levels for various grades of ear. The lowest curve is for a sensitive ear; the designation ten per cent meaning that only ten per cent of the population can hear tones which are quieter than the values plotted. The fifty per cent curve represents the characteristic of an average ear, and that above it is for an insensitive ear; ninety per cent of the people can hear better than this. The uppermost curve is called the threshold of feeling; it specifies the level at which the sound intensity is so high as to be classed as pain.

Figure 1 includes more information than is required for our immediate purposes, but, concentrating on general features, we may note the peaking of aural sensitivity in the region of three thousand c/s with low frequency cut-off in the region of thirty c/s and a high frequency cut-off in the region of ten K c/s. A fact not disclosed by the diagram is the major dependence of this latter quantity

on age group. The correlation between the musical term pitch and the physical term frequency is shown at the bottom of the diagram, and it is to be noted that music exploits substantially the whole frequency range of the human ear. The vertical scales, five in number, are also of note:

Scale 1 is the conventional representation of pressure (fluctuation) in dynes per cm^2.

Scale 2 shows the same information on a barometric scale, in which the unit 'one bar' is normal atmospheric pressure. It is seen then that a pressure fluctuation of amplitude 1/5,000 atmosphere takes us to the threshold of feeling. Normal musical levels are vastly smaller.

Scale 3 expresses the matter on a power basis, watts per $metre^2$; and having regard to the small collecting area of the ear one sees what an extremely sensitive receiver is here involved.

Scale 4 expresses relative power on the usual decibel scale.

Scale 5 is an attempt to correlate all the above with the musicians' scale of loudness, ppp to fff. Only the roughest interpretation can be placed on these

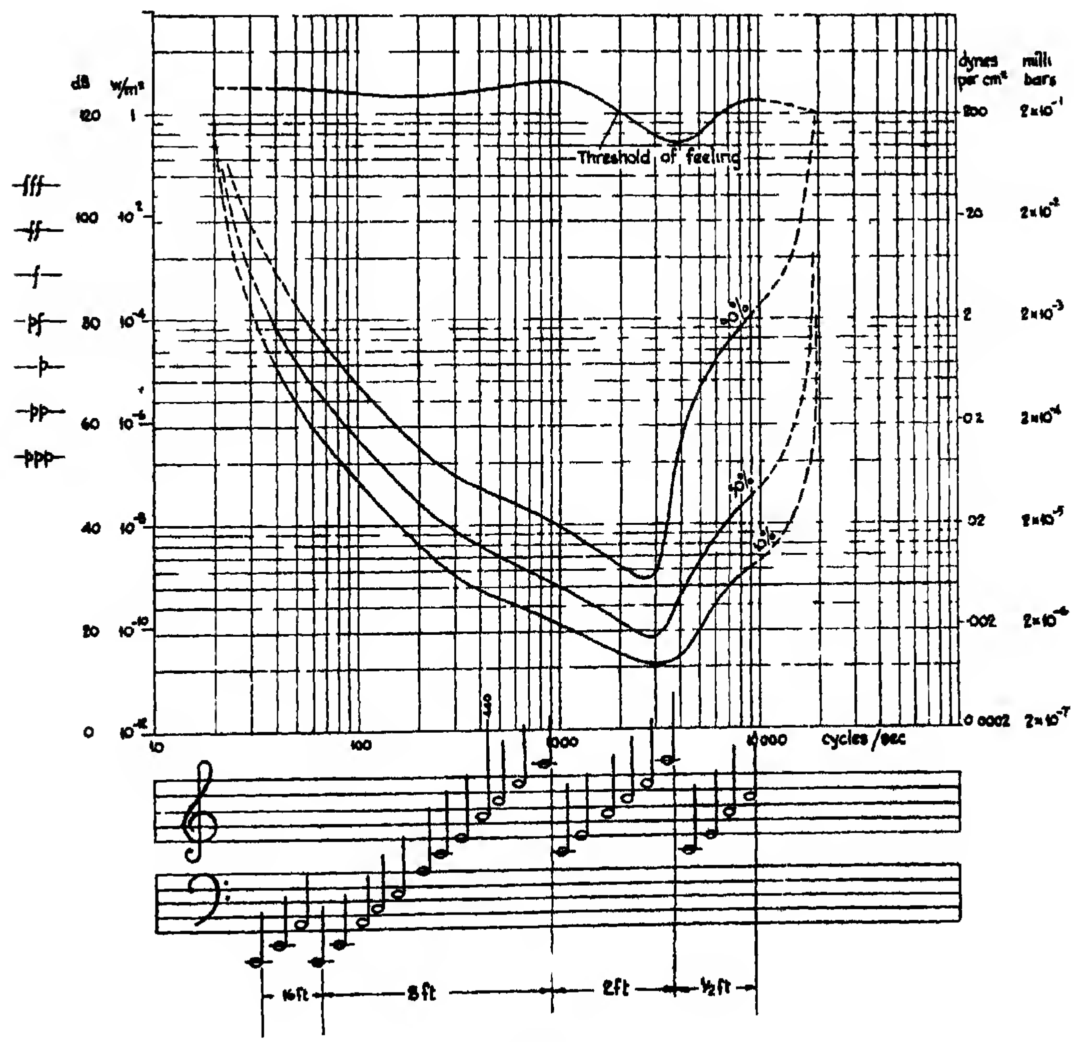


FIGURE I

figures which relate to orchestral studio conditions. (Courtesy of B.B.C. Research Dept.). The tremendous range of amplitudes involved is to be noted. This fact is one of the problems of the communication engineer and the nightmare of the recordist.

Figure 1 may be brought to life by way of demonstrations. In these we make extensive use of 'transducers'. By this term is meant an instrument which receives a signal input in one form and yields a signal output in another, for example:

1. Microphone, which might be termed an 'AC transducing barometer'.
2. Loudspeaker. An AC transducing wattmeter.
3. Cathode ray oscilloscope. The transduction is here voltage into displacement of a visible spot. (*A musical demonstration was then given.*)

The above preamble and demonstrations it is hoped will answer the questions which the musician frequently asks when the physics of music is discussed, namely 'frequency?' and 'frequency of what?'

We come now to the question, with what accuracy of frequency are we concerned in music? This question seems to demand a triple answer:

(*a*) *Absolute pitch.* This faculty, possessed by a minority, is of little importance in music; but a person would be regarded as having a fairly good absolute pitch if he could identify a frequency to an accuracy of about five per cent. (*A musical demonstration was then given.*)

(*b*) *Relative pitch.* This faculty is basic in music, and we may say that for the comparison of two tones adjacent in frequency but not sounded together a sensitive ear can detect a change of 0·1 per cent in frequency. This statement is subject to some qualification as to conditions of test and nature of tone involved.

(*c*) *Pitch discrimination by beats.* When two tones adjacent in frequency are sounded together the frequency discrimination of the ear can be greatly increased by its sensitivity to 'beats'. Beats are the fluctuation of amplitude arising from the interference of two tones neighbouring in frequency. (*A musical demonstration was then given.*)

It is to be noted that the existence of beats does not involve any pressure fluctuation at the beat frequency, but rather a modulation at the beat frequency of the amplitude of a tone of higher frequency.

The ear appears to be sensitive to beats in the region of 0·5 to 10 c/s per second and the fact that such beat frequencies are usually regarded as disagreeable is the basis for most argument on the subject of scales and temperaments.

MUSICAL SCALES

The 'Just Diatonic' scale

Having established a sufficient degree of correlation between the musician's term pitch and the physicist's term frequency, it will now be convenient to

adopt a somewhat dogmatic approach to the subject of scales by writing down a particularly important scale, the 'Just Diatonic', as a series of frequency ratios:

$$1 \quad 1\tfrac{1}{8} \quad 1\tfrac{1}{4} \quad 1\tfrac{1}{3} \quad 1\tfrac{1}{2} \quad 1\tfrac{2}{3} \quad 1\tfrac{7}{8} \quad (2)$$

What is the magic in this particular sequence of numbers that has allowed it to become the basis of Western music for the last many centuries? This question is a difficult one to answer with any degree of conviction. First, we may note that it is made up of relatively simple ratios, that is to say fractions represented by quotients of fairly small integers. The consonant nature of frequencies related by such simple ratios has long been recognized. The basis for this has been emphasized by Helmholtz, namely that such relationships secure the absence of disagreeable beats between the (integrally related) overtones; but (*a*) this scale greatly pre-dates the conception of harmonic music, and (*b*) the basis for the selection of certain simple ratios and the rejection of others is not clear. Table I shows the details of this selection, the absent ratios being denoted by crosses. The selected ratios are shown with reference to a keynote chosen as 'C'. Repeated selections or rejections are shown in brackets.

TABLE I

Numerator / Denominator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1	C														
2		(C)	G												
3			(C)	F	A										
4				(C)	E	(G)	X								
5					(C)	X	X	X							
6						(C)	X	(E)	(G)	(A)	X				
7							(C)	X	X	X	X	X	X		
8								(C)	D	(E)	X	(G)	X	(X)	B

The number of possible rational fractions $\frac{m}{n}$ with $1 < \frac{m}{n} < 2$ and with $n \leqslant 8$ is 21 of which only seven are chosen to constitute the scale. Apart from the presence of all fractions with denominators up to four and the total absence of fractions with denominators five, six and seven, it is difficult to discern any clear pattern in the scheme.

A more revealing approach may be made along the lines of Pythagoras who appears to have regarded the 'perfect fifth' or frequency ratio $\frac{3}{2}$ as the dominant interval. (The musical term dominant possibly derives from this rather than from the modal use of the term.) If we 'unfold' the scale in a sequence of nominal fifths we obtain the sequence of Table II (left-hand main column).

TABLE II

	Just Diatonic			Pythagorean Lydian			Ancient Lydian		
F	$\frac{4}{3}$	$\frac{2}{3}$	$\frac{3}{2}$	$\frac{4}{3}$	$\frac{2}{3}$	$\frac{3}{2}$	$\frac{4}{3}$	$\frac{2}{3}$	$\frac{3}{2}$
C	1	1	$\frac{3}{2}$	1	1	$\frac{3}{2}$	1	1	$\frac{3}{2}$
G	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{40}{27}$
D	$\frac{9}{8}$	$\frac{9}{4}$	$\frac{40}{27}$	$\frac{9}{8}$	$\frac{9}{4}$	$\frac{3}{2}$	$\frac{10}{9}$	$\frac{20}{9}$	$\frac{3}{2}$
A	$\frac{5}{3}$	$\frac{10}{3}$	$\frac{3}{2}$	$\frac{27}{16}$	$\frac{27}{8}$	$\frac{3}{2}$	$\frac{5}{3}$	$\frac{10}{3}$	$\frac{3}{2}$
E	$\frac{5}{4}$	5	$\frac{3}{2}$	$\frac{81}{64}$	$\frac{81}{16}$	$\frac{3}{2}$	$\frac{5}{4}$	5	$\frac{3}{2}$
B	$\frac{15}{8}$	$\frac{15}{2}$		$\frac{243}{256}$	$\frac{243}{32}$		$\frac{15}{8}$	$\frac{15}{2}$	

We see that with one exception all of the intervals are exactly $\frac{3}{2}$; the exceptional interval, D to A, is $\frac{40}{27}$ or $\frac{3}{2} \times \frac{80}{81}$. This last factor is one of the well-known 'commas' of the subject, the comma of Didymus. The same comma applied in different places gives rise to two earlier versions of the diatonic scale, namely the Ancient Lydian and the Pythagorian Lydian. The three scales differ only in the selection of which particular fifth is 'adjusted'. That some such adjustment is inevitable follows in general terms from the fact that no integral power of $\frac{3}{2}$ is an integral power of 2.

Whilst the above shows the arithmetic of the Diatonic scales it does not make it clear what peculiar merit has allowed them, or one in particular, to become the basis for so wide a range of music to the exclusion of so many other possibilities. To cite only a part of the range covered, we may mention Bach, Beethoven, Brahms, Britten, and the butcher's boy on his bicycle. The last is added not only for alliteration but to suggest that there is something about this form of scale which 'comes naturally'. But if this is so the arithmetic fails to reveal it.

Transposing properties of the 'Just Diatonic' scale

The problem of transposition arises only in connection with keyed instruments where a limited number of notes are admissible. The problem is to explore how many notes of a scale, based on a particular keynote, can be used as notes of the same scale based on another keynote. A very simple example will reveal the problem. Consider the scale

C	D	E	F	G	A	B
$\underline{\underline{1}}$	9/8	5/4	4/3	3/2	5/3	15/8

and let us construct the same scale starting on G as a keynote. This simply means that all frequencies are to be multiplied by the ratio of 3/2 and divided by two where necessary to bring them within the octave. We reach

C	D	E	F	G	A	B
1	9/8	5/4	45/32	$\underline{\underline{3/2}}$	27/16	15/8

We find that of the seven notes of the original scale, five recur in the new scale and two new notes are involved, namely (A,5/3) becomes (A,27/16), a sharpening in the ratio of 81/80 and instead of (F,4/3) we get a new note at 45/32, a sharpening of the F in the ratio 135/128. The new note is, of course, the F♯ of the scale of G.

Table III shows the complete scheme of transposition taking six keys sharp and flat on either side of C. Such a table is more interesting to construct than to read, but from it (or from the previous argument) we may deduce the general rule as follows: for each move into the next sharper key the second note of the scale requires sharpening in the ratio 81/80 and the seventh note (leading note)

TABLE III

Key note → / Scale note	G♭	D♭	A♭	E♭	B♭	F	C	G	D	A	E	B	F♯
C		$\frac{80}{81}$	$\frac{80}{81}$	1	1	1	1	1					
	$\frac{256}{243}$	$\frac{256}{243}$	$\frac{256}{243}$						$\frac{135}{128}$	$\frac{135}{128}$	$\frac{135}{128}$	$\frac{2187}{2048}$	•$\frac{2187}{2048}$
D				$\frac{10}{9}$	$\frac{10}{9}$	$\frac{10}{9}$	$\frac{9}{8}$	$\frac{9}{8}$	$\frac{9}{8}$	$\frac{9}{8}$			
	$\frac{2560}{2187}$	$\frac{32}{27}$	$\frac{32}{27}$	$\frac{32}{27}$	$\frac{32}{27}$						$\frac{1215}{1024}$	$\frac{1215}{1024}$	$\frac{1215}{1024}$
E						$\frac{5}{4}$	$\frac{5}{4}$	$\frac{5}{4}$	$\frac{81}{64}$	$\frac{81}{64}$	$\frac{81}{64}$	$\frac{81}{64}$	
F	$\frac{320}{243}$	$\frac{320}{243}$	$\frac{320}{243}$	$\frac{4}{3}$	$\frac{4}{3}$	$\frac{4}{3}$	$\frac{4}{3}$						$\frac{10935}{8192}$
	$\frac{1024}{729}$	$\frac{1024}{729}$						$\frac{45}{32}$	$\frac{45}{32}$	$\frac{45}{32}$	$\frac{729}{512}$	$\frac{729}{512}$	$\frac{729}{512}$
G			$\frac{40}{27}$	$\frac{40}{27}$	$\frac{40}{27}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$	$\frac{3}{2}$				
	$\frac{128}{81}$	$\frac{128}{81}$	$\frac{128}{81}$	$\frac{128}{81}$						$\frac{405}{256}$	$\frac{405}{256}$	$\frac{405}{256}$	$\frac{6561}{4096}$
A					$\frac{5}{3}$	$\frac{5}{3}$	$\frac{5}{3}$	$\frac{27}{16}$	$\frac{27}{16}$	$\frac{27}{16}$	$\frac{27}{16}$		
	$\frac{1280}{729}$	$\frac{1280}{729}$	$\frac{16}{9}$	$\frac{16}{9}$	$\frac{16}{9}$	$\frac{16}{9}$						$\frac{3645}{2048}$	$\frac{3645}{2048}$
B	$\frac{4096}{2187}$						$\frac{15}{8}$	$\frac{15}{8}$	$\frac{15}{8}$	$\frac{243}{128}$	$\frac{243}{128}$	$\frac{243}{128}$	$\frac{243}{128}$

TABLE IV

		C♭	D♭	A♭	E♭	B♭	F	C	G	D	A	E	B	F♯
1	C		987654	987654	1	1	1	1	1	1				
1 0[illegible]463		1 0534 8	1 0 3498	1 0 3478						1 0546[illegible]	1 0546[illegible]	1 0546[illegible]	1 067871	1 067871
1 12246	D				1 111111	1 111111	1 111111	1 125	1 125	1 125	1 125			
1 18920[illegible]		1 170 53	1 185[illegible]	1 18 18	1 185185	1 1[illegible]						1 186523	1 186523	1 186523
1 25[illegible]21	E						1 25	1 [illegible]	1	1 26562	1 265625	1 265625	1 265625	
1 [illegible]4840	F	1 [illegible]	1 168 2	1 [illegible]6[illegible]	1[illegible] 3	1 3 3333	1 3 33 3	1 333[illegible]						1 334839
1 414214		1 404664	1 404664						1 406[illegible]	1 4062 0	1 406[illegible] 0	1 42382[illegible]	1 42382[illegible]	1 423828
1 4[illegible]	[illegible]			1 4[illegible]	1 481481	1 481481	1	[illegible]	1	1				
1 [illegible]401		[illegible]	1 [illegible]024[illegible]	1 [illegible] 4	1 [illegible] 4						1 [illegible]2031	1 [illegible]031	1 [illegible]20 1	1 60190[illegible]
1 681[illegible]	A					1 6[illegible]	1 6[illegible]	1 66666	1 6[illegible]	1 [illegible]	1 [illegible]	1 6[illegible]		
1 [illegible]		1 [illegible]30	1 7 [illegible]30	1 [illegible]	1 [illegible]	1 [illegible]	1 [illegible]						1 [illegible]	1 7078[illegible]
1 88[illegible]48	B	1 [illegible]28[illegible]						1 [illegible]	1 [illegible]	1 [illegible]	1 [illegible]	1 [illegible]	1 [illegible]	1 [illegible]8438[illegible]

is a new note having ratio 135/128 to the nearest note of the previous key. For each move into the next flat key the fourth note of the scale is a new note having the ratio 128/135 to the nearest note of the former key and the sixth note requires flattening in the ratio 80/81.

Table IV expresses the same information as Table III in more readable decimal form.

Figure 2 (see p. 476) is a graphical presentation of some of these facts. For this purpose a logarithmic scale of frequency is appropriate since it allows equal frequency ratios to show as equal distances*. On the logarithmic plot the octave is divided into 12 equal parts (Even Tempered semitones), and each of these into 100 parts or 'cents'. Figure 2, Scale 3, shows the 'Just Diatonic' scale defined above; Scales 1 and 2 are earlier versions of it.

Table V expresses the information of Tables III and IV in logarithmic form, the quantity tabulated being the difference of the frequency ratio from the nearest Even Tempered semitone.

Any of the plots of Figure 2 can be used to establish in slide-rule fashion the transposing properties of the scale concerned. The only difficulty is that the necessary reading accuracy requires a rather large size of plot. (*A musical demonstration was then given.*) Figure 2, Scale 4, is the complete plot of Table IV and can be regarded as the result of carrying out this slide-rule operation six times in each direction.

From Scale 4 or Table V we read some striking information: In the 13 keys, five notes (C, D, E, G, A) are doublets, with separation 21·6 cents in each case. The remaining 12 notes are triplets, an additional separation of 1·9 cents occurring. Scale 4 also indicates clearly those keys in which the elements of the doublets or triplets occur; keys are denoted by the number of sharps (above the base line) or flats (below the base line).

The transposition process has been carried to six keys each way in order to close the cycle and allow comparison of the keys F♯ and G♭, which we are accustomed to consider coincident. It would seem that in fact these two keys are identical in intervals but separated bodily by the interval 21·5 + 1·9 or 23·4 cents. That this constant interval must occur is easily seen; starting from the key of G♭ we will reach the scale of F♯ by 12 successive transpositions of a perfect fifth, and we accordingly recognize this interval as the Comma of Pythagoras, namely the ratio $(\frac{3}{2})^{12}/2^7$ or 1·01364 or 23·4 cents.

The two fixed interval adjustments which dominate the transposition process are now identified as the Commas of Pythagoras and Didymus. (The difference between them, 1·9 cents, also carries a name, the Skhisma.)

* Some musicians may be surprised and apprehensive at the introduction of logarithms into their subject. They should not be, since they can claim to have invented logarithms some centuries ahead of the mathematicians. That this is so is shown by the linear nature of the stave scale in Figure 2. The piano keyboard itself has a logarithmic scale of frequency; a consideration which will doubtless be of great value to pianists in developing their technique.

TABLE V

		G♭	D♭	A♭	E♭	B♭	F	C	G	D	A	E	B	F♯
C	0		−21 5	−21 5	0	0	0	0	0	0				
	100	−9 7	−9 7	9 7						−7 8	−7 8	−7 8	+13 7	+13 7
D	200				−17 5	−17 5	−17 5	−4 0	−4 0	−4 0	−4 0			
	300	23 4	5 8	5 8	−5 8	5 8						−3 9	−3 9	−3 9
E	400						−13 6	−13 6	−13 6	+7 9	+7 9	+7 9	+7 9	
F	500	23 4	23 4	23 4	1 9	−1 9	−1 9	−1 9						0
	600	11 7	11 7						−9 8	9 8	−9 8	−11 7	+11 7	+11 7
G	700			19 6	19 6	19 6	−1 9	1 9	−1 9	+1 9				
	800	7 7	7 7	7 7	−7 7						−5 8	−5 8	−5 8	15 8
A	900					15 7	15 7	−15 7	5 8	+5 8	−5 8	+5 8		
	1000	−25 2	−25 2	3 7	−3 7	−3 7	−3 7						−1 8	−1 8
B	1100	−13 7						−11 6	11 6	−11 6	−9 8	−9 8	+9 8	−9 8

Even Temperament

The Even Tempered scale has by now crept unobstrusively into the discussion, being latent in the ruling on which the plots of Figure 2 are laid out. It consists of 12 equal intervals of $\sqrt[12]{2}$ ($= 1{\cdot}059463$). Its relation to the diatonic scales is evident without further discussion. That it should be acceptable as a musical scale is however by no means predictable, and indeed its introduction was not without considerable opposition. Thus in the literature of the transition period we read such expressions as 'the horrible cacophony of harmony of the Even Tempered scale'[3].

By resorting to an Even Tempered scale we lose all the difficulties which arise from the existence of commas, these being in general an expression of the inequality $(\frac{m}{n})^r \neq (\frac{p}{q})^s$, where all the symbols are (positive) integers. But we also lose the full consonance arising from the occurrence of integral frequency ratios*. Further we lose a former peculiarity of keyed instruments, namely the association of individual 'colours' to the various keys, arising from the fact that in the absence of Even Temper no two keys show exactly the same system of intervals.

One commonly reads that J. S. Bach was a vigorous supporter of Even Temper and that the 48 Preludes and Fugues were written to demonstrate its capabilities. But there are difficulties in accepting this statement. In the first place, it seems

* It is to be noted that the general tendency of modern music towards exploitation of dissonances is a fact which favours (and may partly derive from) the Even Tempered scale

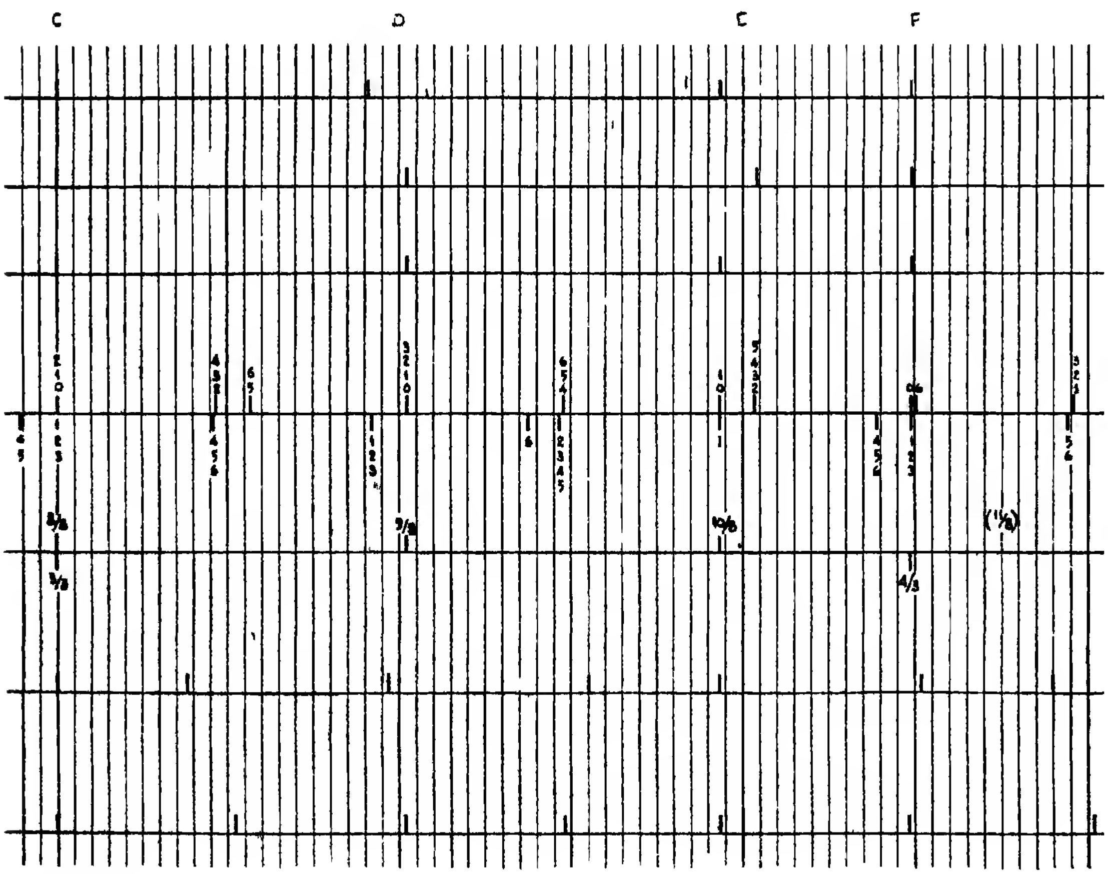


FIGURE 2

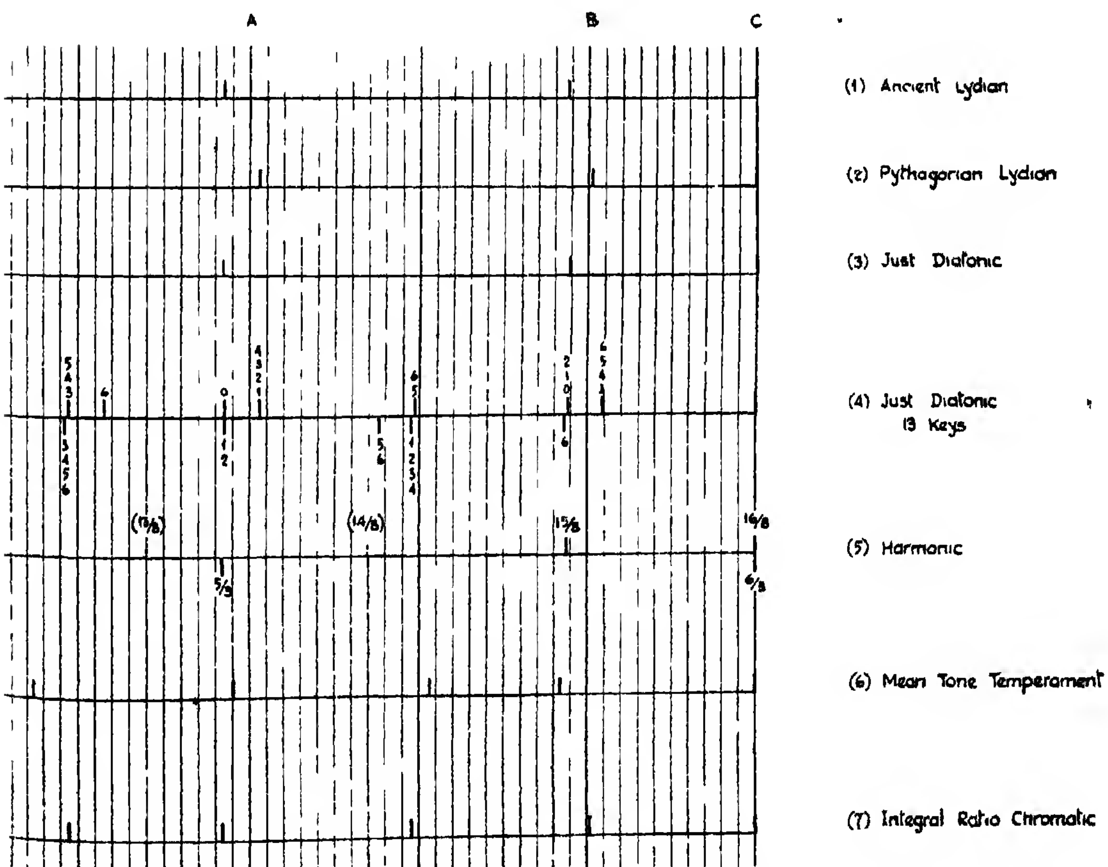
fairly certain that Bach never played an Even Tempered organ, at least not habitually, and that the 'well tempering' of the clavichord on an Even Tempered basis is attributable to C. P. E. Bach rather than to his father. Again a set of 48 pieces to demonstrate this thesis contains a redundancy factor of 24. Even for so prolific a composer as J. S. Bach, this seems a little excessive. It is therefore likely that the 'well tempering' here referred to was in the nature of an approximation to the Even Temper, and indeed it is difficult to see how this could have been otherwise bearing in mind the difficulties accruing from the high decrement of the clavichord tone and the limitation of technical facilities.

What advantage could be expected from a departure from Even Temperament? One frequently reads that orchestras and unaccompanied choirs adopt Just intonation. The writer cannot accept this literally for the following reasons:

(*a*) Historically the organ was introduced into the Church in order to assist intonation of the choir, and it has been doing this *in Even Temper* for the last 100 years.

(*b*) No noticeable change in orchestral quality is observed when accompanying a *piano concerto*; for it is scarcely conceivable (or is it?) that the soloist should play in Even Temperament against an accompaniment in just diatonic.

(*c*) So much of one's musical education is based on an Even Tempered instrument that it would be as difficult for an orchestra to achieve just intonation as it would be for the audience to fail to notice it.



Larger copies of this chart at 24 inches per octave may be obtained on application from the author)

Other Scales.

Figure 2 also records the following scales or temperaments:

Scale 5: This is really an expression of part of Table 1; it shows the harmonics based on fundamentals of $\frac{1}{3}$ and $\frac{1}{8}$ the keynote frequency. If frequencies $\frac{11}{8}$ and $\frac{13}{8}$ are excluded one reaches the Just Diatonic scale.

Scale 6: The Mean Tone temperament. This was in general use for pianoforte and organ tuning for a long period prior to its displacement by Even Temper. A number of versions are recorded of which Scale 6 is representative of later practice.

Scale 7: As recently as 1953 a new scale was proposed by Simonton[4], entitled 'Integral Ratio Chromatic'. This scale has the following arithmetically beautiful scheme:

$$
\begin{array}{ccccccccccccc}
1 \\
\frac{16}{16} & \frac{17}{16} & \frac{18}{16} & \frac{19}{16} & \frac{20}{16} \\
 & & & & \frac{15}{12} & \frac{16}{12} & \frac{17}{12} & \frac{18}{12} & \frac{19}{12} & \frac{20}{12} \\
 & & & & & & & & & \frac{15}{9} & \frac{16}{9} & \frac{17}{9} & \frac{(18)}{9}
\end{array}
$$

The present writer, who had been seeking a way out of the Even Temper disadvantage mentioned above, namely the loss of individual key colours, was much attracted by the I.R.C. scale, and therefore proceeded to tune a piano on this basis. Expectations were not fulfilled; key colours were indeed restored but, in the writer's opinion, in a highly unacceptable manner, reminiscent of the worst defects of the Just Diatonic scale. This experience serves to show the high noticeability of quite small departures from the accepted scales as well as the impossibility of pre-judging a scale on a paper basis.

CONCLUSION

One frequently reads of endeavours to reproduce major classical works in their original orchestral or choral format, and such efforts are praiseworthy enough. But does one ever hear of a production in the original temperament? Probably not, since the subject has practically subsided into oblivion under the triumphant impact of Even Temper. Therefore the proposal of a new scale such as Simonton's is refreshing and encouraging, irrespective of one's personal assessment of the outcome. But the triumph of Even Temper rests on instrumental restrictions which are coming to an end with the introduction of electronic musical instruments. The future remains open to a wide range of conjecture.

MUSICAL DEMONSTRATIONS

These were based on two pianos, kindly loaned by Messrs. Charles H. Challen

& Son, Ltd., tuned one in Even Temperament and one in Just Diatonic. The respective tunings were:

1		1	
1·059463			1·054688
1·122462		1·125	
1·189207	1·185185		
1·259921		1·25	
1·334840		1·333333	
1·414214			1·406250
1·498307		1·5	
1·387401	1·580247		
1·681793		1·666667	
1·781797	1·777778		
1·887748		1·875	

The demonstrations included: Comparison of scales, intervals, and chords; excerpts from Bach's 48 Preludes and Fugues; music written specifically for unaccompanied choir; excerpts from a piano concerto (accompaniment in Just intonation).

REFERENCES

1 A. J. Ellis, Tonometric Observation on some existing non-harmonic scales, *Proc. of Royal Society*, Vol. XXXVII, 20th November, 1884

A. J. Ellis, On the musical scales of various nations, *Jnl. of Royal Society of Arts* Vol. XXXIII, 27th March, 1885

2 H. Fletcher, *Speech and hearing in communication*

3 Helmholtz, *Sensations of tone*, Chap. 16

4 J. F. Simonton, *Jnl. of Acoustical Society of America*, November, 1953

DISCUSSION

MISS DORIS HIBBERT: Could Mr. Bedford tell us how he tuned the piano in Just Temperament?

THE LECTURER: I used electronic aids which I find not only useful but essential! I think the tuning is very accurate. I use a very stable electronic oscillator, calibrated against a crystal. The piano-string frequencies are compared with this and the beats are displayed visually. I reckon to work to an accuracy of about one cent.

In the case of the Just Diatonic tuning, where only integral ratios are concerned, I was able to use only the key-note frequency from the oscillator; hence the calibration of the oscillator is not involved, but only its short-term (two hour) stability.

MR. HENRY WILLIS: I would suggest that no matter how accurately by electronic or other aids one of the pianos used in the demonstrations was tuned to Just Intonation, it must have slipped somewhat since the tuning.

THE LECTURER: I would very much like to cross swords with you on that point. I think that the piano tuning is very accurate indeed, but, subject to measurement, I must bow to your ear in the matter. I am going to make a rude suggestion to you. I do not believe that you have ever heard Just Temperament. I think it has not been heard for 100 years, and you cannot be as old as that!

MR. WILLIS: When I was a very young apprentice, I was taught Mean tone or Just intonation to show me what to avoid!

MR. M. T. BIZONY: Does Mr. Bedford agree that with Even Temperament it is a waste of time for a composer to make any sort of fuss about the key he is writing in except whether it is a minor or major key? Anything else that he may determine by writing in A major rather than in say, B major is merely the pitch; but if we have Just Diatonic scale, then we retain an individual quality with each key.

THE LECTURER: I agree with that statement, and I am very glad you have raised the point; I omitted it for the sake of brevity, but it is a very important one. There is this residual question: does there exist individual key colour in spite of Even Temperament? When I play the piano myself I suspect that there is, but I am unable to detect it from someone else's playing.

One of my reasons for exploring this apparently dead piece of ground (for after all this subject was wound up at the end of the last century and buried) is that, as I have hinted, I am very interested in electronic organ design, and the question of temperament is most important. I was very reluctant to see a complete loss of key colours by the adoption of Even Temper, and I was looking for some way of restoring individual key colour. Of course, you can get it, but I regret to say that every scheme I have tried I have found extremely disagreeable. I have grown absolutely Even-tempered ears as a result of my investigations.

DR. G. L. HAMBURGER: I find it extremely difficult, first of all, to find any significant difference between the two pianos used for the demonstrations. I must admit that the lecturer played essentially things in one key, the main one being D major.

Although I have been interested in music all my life, I may have been spoiled in my hearing, as in the first place I was interested in the piano, which is usually an Even-tempered instrument. Had I been an oboe player I might have thought differently. But it seems that, maybe due to the fact that the majority of people are educated on the piano and have a lot to do with it, the taste of the finer feeling for these differences has been blunted in a way. This limitation must have cost me much, insofar as I still cannot hear the difference between the two pianos—in the way of hearing alternative examples. Of course, if two notes are struck at the same time I perceive the beat, but otherwise I find there is very little in it.

MR. CLIFFORD LAWSON-REECE: Profoundly impressed though I was by the admirable demonstrations on these two pianos, I cannot help feeling that one may be beguiled by the characteristics of one particular piano into thinking that what one hears is a function of the scale when it may be a function of that particular instrument. Has Mr. Bedford succeeded in making any device work on piano or organ for shifting the temperament in the same instrument?

THE LECTURER: I have conceived such a device, but I have not produced it. That, of course, will only apply to electronic instruments and is quite out of the question, in my opinion, on a mechanical one.

BRIGADIER J. L. P. MACNAIR: The lecturer wondered how it was that the orchestra managed to keep in tune with the piano when playing a piano concerto. He also said he would not use voices in this meeting because a voice never kept in tune. Fair enough. Exactly the same thing of course applies to those parts of an orchestra who can adjust their pitch. The wind instruments are not quite so easy, but if the strings of an orchestra are playing with the piano, they always quite naturally tune themselves to the piano. In connection with that it is interesting to remember that the old harmonists refused composers the use of consecutive fifths. My impression is that though the reasons advanced for that had something to do with the mixup of keys, the real reason is probably much more closely connected with the Even-tempered scale, which gets you in the wrong if you do try to use consecutive fifths. It is true that modern composers are tending to bring back consecutive fifths, but they are doing that as a matter of brute force rather than theory. If you play consecutive fifths on a violin they sound perfectly alright because the violinist can adjust the intervals correctly.

Although the impressive hymn of Benjamin Britten's was very good, I wonder if you are acquainted with Holst's treatment of the hymn known as *Turn Back O Man*,

which I think is even more impressive in the remarkable way, harmonically, that he deals with these changes of key.

THE CHAIRMAN: I think that the lecturer had a bitter lesson when he heard us sing in various temperaments in the hymn!

MR. ARTHUR PRIESTLEY: Would the lecturer agree that the particular colours which some people claim to feel as belonging to different musical keys may in fact be related to the position of the hands on the keyboard, to the comparative difficulty of a scale, and so on? Would one have a favourite key as dictated by that? Does a person with a sense of absolute pitch, not knowing what key is being played, detect any difference between the keys? And with regard to the performance of a piano concerto, is it not true that most of the string players use a pronounced *vibrato* which irons out the discrepancies between tempered and untempered scales?

THE LECTURER: I think I agree with both your points. The hand position has a lot to do with it, and I certainly agree with you about *vibrato*.

A vote of thanks to the Lecturer was carried with acclamation, and the meeting then ended.

The following communication has since been received from Mr. Bedford:

Since my suggestion that the future of the organ lies in the electronic version met, as expected, a strong opposition, may I be allowed to develop this theme?

It is fairly generally experienced that, when one changes over from a mechanical to an electronic solution to a given problem, one finds that the latter is over-solved in the sense that one has introduced tremendous reserve factors and an unprecedented flexibility. The 'dividend' can be taken up in various ways. In the case of the electronic organ, it has hitherto been almost exclusively taken up in cost economy. Thus when we compare pipe organs and electronic organs, we are usually comparing instruments in totally different price categories; indeed, the price ratio may exceed ten to one. In these circumstances, it is hardly surprising if the electronic organ falls short of the pipe organ as a serious musical instrument. Its very cheapness has tended to accentuate its application (with good effect) to light music; and incidentally, for no apparent reason, to the especial use of organists who have suffered the loss of the right leg.

If, however, one is prepared to sacrifice some part of the great economy offered by the electronic solution then the situation may be transformed. In the first place, the output amplifier and transducer may be stepped up from, say, twenty watts to two hundred watts or more. Next, all the important organ tones can be produced with adequate accuracy, and in addition new tones unknown to the pipe organ can be produced. The dynamic range of the 'swell' is enormously increased and can be applied to stops individually. Similar remarks apply to *tremolo* and *vibrato* tones.

Then there are the possibilities relevant to the present paper, hitherto quite unexploited, that the temperament can be altered in play. This would imply the provision of a range of buttons to cause the temperament to be shifted with modulation. In the converse direction when playing in Even Temper one might wish to resort to 'tempered harmonics'. (This is already done in the Hammond organ, probably for reasons of economy only; it is an interesting effect and should be of value if not applied exclusively.)

Finally, we may note that the electronic organ can be tuned in five minutes and will stay accurately in tune for an indefinite period. It is suggested that the pipe organ presents the exact antithesis.

In view of the above, and having regard to the general trend of events in technology and instrumentation, it seems reasonable to conclude that within the next hundred years it will be as unnatural to design an organ on a pipe basis as it would be to-day to design a television receiver with a mechanical scanning disc.

THE SECOND EVENING DISCUSSION MEETING

SPORT WITH SOME REFERENCE TO THE GROWTH OF PROFESSIONALISM

The second of the three evening discussion meetings arranged for the present Session was held on Wednesday, 29th February, the subject for discussion being introduced by Mr. Denzil Batchelor. The meeting was presided over by Sir Harold Saunders, a Member of Council of the Society.

Mr. Batchelor said that he wished to confine his remarks to the place of sport in present-day society. The appeal of sport in the modern world could be held to be desirable, and should not be derided. Sport, to be worth-while, had two immense charms, and if it lacked either of them it would not be worth watching: it was an art, and it appealed to the human interest in the competitive or gladiatorial. No sport which was not beautiful in movement was fit to be watched. Sport to-day had, however, developed into an industry. Was that to its advantage and benefit, and what was the result of the professionalization of sport? The instance of the 1952 Olympic Games was quoted when, of the 69 nations taking the oath of amateurism, there were in fact very few amateur teams. That was not far from the truth at Cortina this winter. There the two great countries which led the way were America and Russia. The Russians said that every member of their team was a full-time worker. Their best skier worked in a metallurgical factory—but he had not clocked in for four years. He lost the combined events, and sadly commented, 'Back to the metallurgical factory!' There was no doubt that any Russian teams sent to this country were on propaganda missions, and in fact endeared their country to the British public by playing extremely good sport. They were undoubtedly playing for world popularity through their sportsmen.

On the other side of the fence there was America, who had recently disqualified Santee. There were cases of American athletes who received expenses and other monies, and there was no doubt that any first-class American athlete was able to earn his living out of sport as an amateur.

In lawn tennis, which prided itself on amateurism, amateurs and professionals were not allowed to meet. A critic had been once heard to say, when a British champion was knocked out at Wimbledon, that if things got any worse some of our professionals would have to turn amateur to make a good living!

We spent as a nation more on gambling than we did on police stations or education, with the possible exception of university education. In 1954 £350 million was spent on horse racing, £120 million on dog racing, £74 million on football pools, and £6 million on other forms of gambling—a total of £550 million. £9 million also went to the Irish sweepstake, of which 3*s*. 9*d*. in every pound spent benefited the hospitals.

Cricket was one of the least rewarding of sports financially. A good cricketer received £15 a week during the summer, and £6 during the winter, whereas in lawn tennis a player would make £15,000 in his first year as a professional. A golfer could make £3,000 a year, and he could keep it up till he was 45 through

teaching and coaching. Probably one of the highest paid of all sportsmen was the winner of the Tour de France, mainly because of the sums gained by the winner through advertising. Footballers were paid £15 a week during the winter, whereas some baseball players earned £33,000 a year. The most successful boxers also received huge sums of money: Joe Louis made £1 million.

In the general discussion which followed, the point of view of the seasoned lawn tennis player was put. For example, when playing at Queen's Club thirty years ago, one speaker had had to wait all day for a well-known British player. When he complained that he had a business to attend to, the referee told him that he had no right to have a business and play tennis! On the question of expenses, a certain famous Australian player demanded £20 a day for himself, while even moderate players wanted large sums.

The view was expressed that professional and pseudo-professional sport should be regarded as a form of exhibition. This was quite different from the position of the man who played the game himself and who went to see the expert for the pleasure of learning how the game should be played. It did not matter very much whether the exponents of those sports which were most beautiful to watch were professionals or not. Football and cricket owed a great deal to the professionals. They played the game because they loved it, and they could not afford to play for pleasure only. They were as good sportsmen as the average amateur. Again, it was not felt to matter that so much money was spent on one particular form of entertainment. Not professionalism as such, but sham amateurism, was felt to be undesirable. The Olympic oath of amateurism, reasonable in 1896 was now, it was held, an anachronism. It was suggested that the need to-day was for a distinction between the professional and the pseudo-amateur to be broken down.

In team games also just as much interest and excitement could be derived from seeing a very moderate team playing a good and enthusiastic game, because here was a combination of people who had been accustomed to playing together. It was very important that in decrying the professional form of sport it should not be implied that amateur sport was not immensely valuable. The experience derived from playing difficult games at school under uncomfortable conditions was, it was suggested, extremely valuable later in life.

It was suggested that promoters of football pools might be encouraged to give a small percentage of their profits to pay for the training in sport of young people who showed talent. The view was put forward that it was generally the sporting bodies themselves who declined to accept such money because, if the pools promoters helped to pay for the education and development of promising young athletes, they would want a say in the handling of the sport, which was not felt to be desirable. As against that, Swiss state-controlled pools on British football had subsidized the Swiss contingents at the Olympic Games. Such a scheme, it was held, might be feasible here if legislation were strong enough to prevent the promoters from having any say whatsoever in the game, but it would require strict controls and an impartial administering body.

Other points touched on were the shortage of playing fields in London; the

disproportionately large amount of space devoted in newspapers to sport; the need for greater accommodation at sporting events, and the lionizing overseas of ace cyclists.

Those who took part in the discussion included Mr. A. C. Chappelow, Wing-Commander T. R. Cave-Browne-Cave and Mrs. Hamilton Ellis.

GENERAL NOTES

THE ROYAL ACADEMY SUMMER EXHIBITION

Since the last war, and especially in the last few years, the Summer Exhibitions of the Royal Academy have undoubtedly given a truer notion of the prevailing artistic climate than at any time since the later Victorian age. The present 188th Exhibition, which mixes expressionist or inventive realist painting with the Academy's more conventional products, certainly seems as adventurous as the institution can well contrive. No Hanging Committee, of course—not even one that includes, as this does, artists as liberal-minded as Mr. Ruskin Spear, Mr. James Fitton, or Mr. Rodney Burn—can hang abstractions if the better abstract painters hold back, or persuade such distinguished outsiders as Sir Jacob Epstein and Mr. Moore, Mr. Sutherland or Sir Matthew Smith to come in against their will. What, however, can truly be said is that the progressive element within the Academy is now sufficiently strong to ensure that such lamentable mistakes of the past as the rejection of an important Wyndham Lewis portrait are now unthinkable.

Anyone can imagine how various are the personalities, and conflicting the opinions, within an assembly like the Academic body; and it says much for the diplomacy of the President, Professor Sir Albert Richardson, that a catholic policy has neither restrained a freedom of artistic expression, nor endangered an annual attendance which hitherto has consisted largely of very conservative supporters. Evidently that public is not so insular as it was before the war, and in meeting a more informed taste—indeed, in helping to raise it—the Royal Academy is certainly not being untrue to its heritage, and can suffer an occasional outraged protest with some composure. The Academy of such independent and questing masters as Constable and Turner, with their great influence on French thought, was very far from being a backward institution, the reproach which for so long afterwards it was to carry.

All this is not to suggest that the present exhibition approximates to a kind of enlarged London Group show, though there is, in fact, some semblance of it in Galleries VII and VIII. The most conservative visitor may be reassured, as he mounts the staircase, by the extraordinary fidelity of Mr. Maurice Lambert's bronze figure of Dame Margot Fonteyn in the Central Hall, an effigy faithful even to the artificial eyelashes observable on closer inspection; and fortified by what is, after all, something of a *tour de force* of its kind, the same visitor may only begin to feel misgivings about such theatrical naturalism when he encounters a sample as meretricious as Signor Annigoni's painting of the same *ballerina*.

If it be true that most ordinary visitors have become better acquainted with serious (as opposed to popular) painting, one may hope they will appreciate, by contrast, the grave distinction of Professor Rodrigo Moynihan's half-length portrait of the Earl of Radnor, rightly hung in the main gallery. It might be called a 'thinking likeness'; and if the features appear unduly pensive to those who know our Bicentenary Chairman, it might be remembered that a cast of expression natural for anyone enduring long sittings is also typical of the meditative portraiture of that Euston Road Group in which the artist's style was formed. This is, in fact, one of several paintings that command attention in a gallery inevitably dominated by Mr. Ruskin Spear's powerful figure of Sir Laurence Olivier in the character of Macbeth, a giant trapped and awaiting the final catastrophe. It is flanked by Mr. R. O. Dunlop's large

and substantial Spring landscape, which holds its own well against Mr. Alan Reynolds' imaginative Summer landscape, recently seen at the Redfern Gallery, and now exhibited as a Chantrey purchase.

In an exhibition containing over 1,400 items, it is only possible to indicate general trends and illustrate them with a few examples. One effect of spreading so many interesting and unorthodox paintings throughout the galleries has been to divert attention from the more formal and conventional portraiture, such as normally gratifies private viewers. However, a former Master of the Leathersellers' Company has been meticulously recorded by Sir Gerald Kelly, as indeed have Lady Lowson and her family by Mr. James Gunn, both artists having fared better than other official portraitists whose canvases have been rather tucked away. There may be noticed, however, in Gallery IV, Miss Anna Zinkeisen's ceremonial portrait of our President, His Royal Highness The Duke of Edinburgh, as Marshal of the Royal Air Force. Also in this room is an extravaganza by Sir Alfred Munnings which depicts a group of visitors, including the Director of the Tate, contemplating an amorphous object which is presumably intended to represent a piece of contemporary sculpture. It is a curious painting, not least because the exaggerated antics correspond so closely to comical Toby-jug ware, the final touch of improbability being added by a country dog to balance the composition.

In addition to satirical paintings, and an unusual number of street scenes, there is a stronger representation than usual of what might be called inventive realist painting, particularly in Galleries VII and VIII. Mr. John Bratby and Mr. Edward Middleditch are two of the younger realists seen here for the first time, not, indeed, as well as they might have been if so many of their canvases had not been reserved for this year's Venice Biennale. Mr. Peter Coker also comes in with his paintings of butchers' carcasses in that dour, relentless mode introduced soon after the last war by the French realists. On the whole, however, it is the more experienced painters who score here, especially Mr. Carel Weight, whose big painting of workers swarming out of a greyhound racing stadium seems, on the face of it, a mass of improbabilities—so imaginatively resolved that the spectator can come to share a visionary experience of a commonplace Saturday event.

The water-colours, drawings and prints maintain their usual standard. A high level of craftsmanship is ensured by the number of members of the Royal Water-Colour and Painter-Etcher Societies who annually exhibit; and it is refreshing when craftsmanship is combined with such imagination as is displayed by Mr. Farleigh in the black-and-white room, or Mr. Vivian Pitchforth in his fluid and spacious water-colours. To the South room the President contributes five works, including an architectural *capriccio*, and, elsewhere, his proposed reconstruction of the Merchant Taylor's Hall. Besides Mr. Maurice Lambert's bronze dancer, already mentioned, there may be noticed good characteristic sculptures by Mr. Willi Soukop and Mr. Siegfried Charoux, a conspicuous bronze of a *Little Girl* by Mr. Sydney Harpley, rather after the manner of Manzù, and Mr. Frank Dobson's *terra-cotta* statue which is no less monumental for its small scale. There is no reason to suppose that this diversified, and often adventurous, exhibition will fail to draw crowds almost as great as the record attendance last year.

As much space is certainly due to the important exhibition of German painting, 1850–1950, at the Tate Gallery, though it must suffice to comment on it briefly now, and point out that it is the most representative of its kind yet seen in this country. Not, indeed, since the 1938 exhibition of modern German art banned by Hitler has anything approaching the present collection of over 250 paintings and drawings been brought to London. In addition to the more prominent German painters of the last century, the exhibition includes valuable groups of paintings by Klee, Kandinsky, and Herr Kokoschka, whose influence on modern art has been pervasive.

NEVILE WALLIS

THE LIBRARY

The definition of a policy for the Library of a body such as the Royal Society of Arts, which is so wide in its scope but restricted in its library space is not a simple problem. Practical considerations necessitate a considerable degree of specialization within the extremely broad field covered by the Society but the selection of the most suitable specialized subjects must depend on varying circumstances, some of them, such as the existence of other collections, external, and the matter therefore calls for periodical review. It may be helpful to Fellows to publish the following list of subjects upon which the present policy is to concentrate and to draw their attention to the fact that a number of volumes outside these categories have recently been disposed of in order to make space for growing collections within the chosen categories. The subjects in which the Library is now specializing are as follows:

THE ROYAL SOCIETY OF ARTS: The history of the Society is illustrated by its published proceedings and manuscript records, and by secondary works on technological, economic, social and art history.

OTHER LEARNED SOCIETIES: The domestic histories of other societies are of continuing value to the Library.

EXHIBITIONS: Because of the Society's pioneer work in this sphere, the Library will continue to add to its collection catalogues and descriptive works relating to the major international exhibitions, and any small ones particularly concerned with industrial design or showing advanced exhibition architecture or display.

SCIENCE, AGRICULTURE AND TECHNOLOGY: The Library attempts to cover the general history of science, technology and agriculture, with particular emphasis on the period 1750-1850. But it cannot concern itself with the history of science and technology since 1875. The Society's journal is a reasonably good source for much of this history, and it is clearly impossible to cover the vast subject adequately.

ENGLISH HISTORY: The Library has a limited collection of background material and emphasis is placed on economic and social history since 1700.

THE HISTORY AND TOPOGRAPHY OF LONDON: There is a small but useful collection of books on this subject.

BOOKS PUBLISHED BEFORE 1830: The Library has an interesting collection of books on technology, commerce and agriculture published before 1830, many of which are known to have belonged to the Society since the eighteenth century. They are equally useful for the documentation of the Society's own history and to the section on the history of technology.

THE INDUSTRIAL ARTS: The Library will continue to make the industrial arts its main subject. There is already a good and useful collection; the periodicals particularly are valuable, and their value will naturally increase with every year's addition.

The Library endeavours to cover all branches of design, English, Commonwealth and foreign, with adequate illustration. Much of the illustration, and some of the information, required can be found in periodicals: for example, current machine design is only well represented in the United States periodical *Industrial Design* and the Italian *Stile Industria*. There are also books on what may be called industrial æsthetics (as opposed to practical design). The history of design and the history of taste since 1750 are covered; an attempt is being made to see that all periods are adequately represented in such branches as furniture and textiles, and that the Library shall contain illustrated examples of pattern and ornament of all periods and countries.

The development of taste is illustrated by the history of architecture and the fine arts as well as the industrial arts; and the history of English painting in the period 1750-1850 also has particular relevance to the Society's history. But from 1850 development in design in the industrial arts and architecture, and to a lesser extent painting and sculpture, cannot really be separated; from William Morris onwards the same æsthetics have found expression alike in architectural and industrial design, and since these æsthetics, which in the result become styles, are the basis on which

design for whatever purpose is critically considered and historically placed, material has to be provided for their illustration in all their manifestations.

BOUND PERIODICALS: Back numbers of the following periodicals have been kept and bound since the date shown. Fellows are reminded that they can be borrowed on the same conditions as other works in the loan library.

Agricultural history (American)	1950
Agriculture (*Journal of the Ministry of Agriculture*)	1949
Ambassador	1949
American philosophical society (*Proceedings*)	1744 (less 1928–48)
Antiquaries journal	1921 (less 1939–48)
Architectural design	1951
Architectural review	1949
Architecture and building	1949
Archives	1949
Ark (*Journal of the Royal College of Art*)	1951
Arts and architecture (American)	1950
Art and industry	1949
Art et industrie (French)	1948
Art and letters (India and Pakistan)	1948
Asian review	1952
Aslib proceedings	1950
Bhandarkar oriental research institute	1947
Bonytt (Norwegian)	1949
B.B.C. quarterly	1949
British plastics	1949
British society of master glass-painters (*Journal*)	1949
Burlington magazine	1953
Canadian art	1949
Ciba review (Swiss)	1937
Colonial geology and mineral resources	1950
Colonial plant and animal products	1950
Country life	1949
Dansk kunsthaandvaerk (Danish)	1948
Design	1949
Discovery	1948
Display	1949
Domus (Italian)	1949
Edilizia moderna (Italian)	1949
Endeavour	1949
Far and wide	1948
Form (Swedish)	1948
Gebrauchsgraphik (German)	1953
Geographical journal	1857 (less 1939–48)
Geographical review	1949
Graphis (Swiss)	1949
Industrial design	1954
Institute of navigation (*Journal*)	1948
Japan society bulletin	1951
Journal of æsthetics and art criticism	1949
Journal of documentation	1950
Journal of the Franklin institute	1928 (less 1938–48)
Linnean society of London journal	1949
London society journal	1949
La Maison (Belgian)	1950

OBITUARY

LT.-COL. S. E. GLENDENNING

We record with regret the death, in Norwich recently, of Lieut.-Colonel S. E. Glendenning.

Sydney Elliot Glendenning, D.S.O., T.D., F.S.A., M.I.E.E., a Freeman of the City of Norwich, although by profession an engineer, was closely concerned with the fundamentals of traditional building in East Anglia, on which subject he was an authority. He became a member of the Society for the Protection of Ancient Buildings in 1911, and was for 22 years a member of its committee, on which his great knowledge of the buildings of Norfolk was of great value in furthering the work of the S.P.A.B.

He was elected a Fellow of the Society in 1938.

CORRESPONDENCE

THE IMPERIAL INSTITUTE

The letter which was published in the last issue of the Journal *from Mr. Martin A. Buckmaster, who remembers the opening of the Imperial Institute, prompted a request to another Fellow, Mr. Stanley Hamp, formerly a partner of Thomas Collcutt, to contribute to the* Journal *some remarks on the original plan for the Imperial Institute's site. In reply, the following letter was received*

From MR. STANLEY HAMP, F.R.I.B.A., HILLYHORN, OAKRIDGE LYNCH, STROUD, GLOUCESTERSHIRE

I was too young to remember the erection of the Collcutt building, and the great occasion of its opening, but some years after its completion I was taken in as a pupil by Mr. Collcutt. After qualifying for R.I.B.A., I started in practice on my own, but within a few years Mr. Collcut asked me to rejoin him as a junior partner and I remained with him until he died.

He was very proud of this work of his—the Imperial Institute—and told me interesting facts as to the lines he worked upon on its erection. The principle underlying the scheme appealed to him, as he at once saw its possibilities. It was a chance for a fine and noble conception. The site available extended then north and south from the Albert Hall to the Natural History Museum, and east and west from Exhibition Road to Queen's Gate. It was quite free of any important existing buildings, forming a rectangular site in which he could design the new building.

He decided to place his building centrally, with the great tower rising to form a fine composition and having space available for the creation of a well-laid-out pleasure garden such as was suggested by the conditions of the competition. The high floors now condemned were required for conference rooms. Visualizing that there might be a change in the future, Mr. Collcutt decided on a height that would make it possible to insert an intermediate floor if required. The Great Hall which he designed was provided as a temporary structure, and long galleries were designed to the north elevation at ground-floor level.

The streets on the east and west sides he designed to be widened and made into tree-lined avenues with government buildings on each frontage. He saw such a scheme as a fine town-planning effect worthy of this Kensington area. Alas, new buildings were allowed to be erected without any regard to each other and in an entirely wrong position. His great vision vanished and this opportunity was lost, with the present result: an illustration of *very bad* town planning. The sites on the opposite side of Queen's Gate and Exhibition Road could now, however, be secured with government powers. These would provide very valuable sites for the enlargement of the Imperial College buildings and for other government buildings and

would form, over a period of years, a fine architectural expansion. Such an opportunity should not now be missed.

The present scheme will be another illustration of that which is done in haste without due consideration ending by being regretted by future generations. The Imperial Institute should have inspired the planners to include it as a unit enhancing the whole scheme, however modern the new architecture might be.

NOTES ON BOOKS

PACKAGE DESIGN. *By Milner Gray. Studio*, 1955. 25*s*

Packaging is one of the most interesting and stimulating of the fields of design in industry. There are few more direct links, in our commercial world, between the designer and the people around him, and not only is the range of products packed under brand names increasing every day, but new packaging materials and techniques are continually being developed. As Mr. Gray says:

> Packaging, in the broad modern sense, involves the service of a vast combination of industries, employing hundreds of thousands of men and women, consuming ton upon ton of paper, board, foil, metal, fibre, film, pulp, glass, clay and plastic powder, and utilizing many types of precision machines to print, press, mould, fold, stopper, seal twist, count, stamp and shape the millions of containers in which these goods are packed

The designer, although he must understand them, would be unwise to try to master all the different techniques, and for the student a very valuable part of this book, No. 59 in the 'How To Do It' series, is that in which five experts discuss 'Production Line Technique', 'Printing Processes and Packaging', 'Metal in Packaging', 'Glass in Packaging', and 'Plastics in Packaging'.

All the effort of design is of course dedicated, as Mr. Gray emphasizes, to the hard fact of selling the goods. One manufacturer's salt may look very much like another's in the salt-cellar, but the housewife has got to be persuaded when she is at the shop that so and so's salt is the best It is at this point, of course, that the strictly visual part of design comes into play. In packaging for the sale of goods a serviceable container is not enough', and a mastery of techniques without a feeling for good design will not give the required results. An international choice of illustrations in this book shows many examples of achievement in packaging in this visual *rôle*, and also in relation to particular problems of protection and distribution.

'In the sphere of design, there is no finality', is a thesis illustrated here by the gradual changes since 1907 in a Cadbury's wrapper. This book very successfully accomplishes what it sets out to do, to give the 'simple technical background facts about packaging', and since there can be no finality there follows the challenge: Beyond this it is to himself alone that the student must look'.

MICHAEL OLIVER

TECHNICAL EDUCATION: ITS AIMS, ORGANIZATION AND FUTURE DEVELOPMENT. *By P. F. R. Venables. London, Bell*, 1955. 42*s*

How to review, in some 600 words, a book of as many well-filled pages? The only thing to do is to start with an assertion couched in superlatives: Dr. Venables has provided us with a major work of most meticulous scholarship, he has composed the heterogeneous activities called technical education into a coherent picture; by skilful writing and pleasant wit he has preserved a monumental mass of data from what would have seemed to be inevitable dullness. In his introductory chapter Dr. Venables regrets that there exists no comprehensive history of English technical education: on the evidence of this volume he is the man to write it.

As T. H. Huxley pointed out in his 1887 Manchester address, 'It passes the wit of man . . . to give a legal definition of technical education', but Dr. Venables has

performed the more useful task of giving an adequate description of it. He shares Huxley's conviction that technical education must be wider than mere instruction and that in the long run the decisive problems of industry are human problems, and he makes it clear that we shall not make up the leeway in the technological race of the nations until technical education is lifted from its present lowly social status.

Recognizing the varied nature of the terrain he is mapping, Dr. Venables has called in specialists to write on engineering, building, art, commerce and the further education of women; but it is the senior author's chapters, fully documented by bibliographic references and clearly illuminated by many excellent tables and charts, which give this volume its classic quality. His account of the character and range of technical education institutions, and of their general working arrangements and courses, is a model of the manipulation of heavy matter into light reading. His description of the complex partnership, involving so many departments, committees, associations and unions, which regulates technical education is clear and precise—but one yearns to manipulate Dr. Venables's own delightful invention, 'a new Occam's razor for Administrators, "Administrative procedures are not to be multiplied without dire necessity" '. It is, however, in the last six chapters of the book that we become really aware of the author's power of mind.

The chapter on 'Higher technological education' begins with a vigorous thrust at the procrastinators and double-talkers of every ilk, proceeds to harass the hair-splitters and cheese-parers, confounds those who lack faith in the intellectual estate of the British people, and playfully pricks those still inhibited by 'our gentlemanly ideals' of education. Next comes a chapter on 'Freedom and governance', boldly claiming for technical colleges some of the autonomy anciently enjoyed by the universities and now extended to every school in Hertfordshire, and making overdue assertion of the proper prerogatives of principals (but, regrettably, saying little about the democratic rights of lecturers *vis-à-vis* principals). All this, and the frequently reiterated complaint of the low status of technical education, and the evidence adduced about the inferiority in which technical colleges stand compared with universities as to salaries and staffing ratio and scholarship provision, seems logically to lead to a demand for full university status for the major colleges of technology. This step, however, Dr. Venables does not take: 'the idea that the university is the sole source of ultimate academic authority' he discounts.

Does he, perhaps, protest too much? At any rate, whatever the final solution, this volume poses the problems in masterly manner.

CYRIL BIBBY

MASTERPIECES OF GREEK DRAWING AND PAINTING. *By Ernest Pfuhl, translated by J. D. Beazley. London, Chatto & Windus*, 1955. 63s

It is nearly thirty years since Ernest Pfuhl's book was first published. With the passing of time a new interest in Classical art has been awakened. Our approach has broadened. This new edition is therefore specially welcome. The book is what its title suggests—an anthology of masterpieces with a vivid critical commentary which answers just those questions which the pictures raise. While not claiming to be historically exhaustive or scientific, this broad survey reflects deep understanding of the subject.

Professor Pfuhl's introduction starts, as indeed must any true assessment of the Greek genius for art, with form in the round. 'At the mention of Greek art', he says 'everyone thinks first of Greek sculpture'. Greek art is essentially and always a figural art expressing through form and line the ideal of man embodied in the phrase at the entrance to the Delphian Temple of Apollo: 'Know thyself'. It is, in fact, from this basic conception of the significance and supremacy of the human values of Greek sculpture that he proceeds to an examination of the development and interplay

of monumental art and vase painting, and from these to engravings, mosaics, wall paintings, mummy portraits and the rest.

But vase-paintings take up the larger part of the book. Greek vase-painting was restricted in technique and imagery. Like sculpture, 'it was dominated by the figure', and landscape had little or no place in it. Moreover, it was never painting in the modern sense, and therefore bears no comparison with, say, the ceramic painting of Meissen, Sèvres, or Chelsea in the eighteenth century, or for that matter with anything in oriental art. It was always decorative, tectonic, and 'adapted to the special conditions' of the potter's technique, and its development 'led not to painting proper but to pure drawing'.

The quality of that drawing varied in different periods. Professor Pfuhl's introduction and commentary unfold admirably the evolution of vase-painting through its main styles—black-figure, red-figure, and white-ground—to its eventual 'death in beauty'.

One of the most fascinating parts of this book is concerned with the more disputable monumental paintings of the Greeks which are known to us only through wall-paintings of the Roman period. As to how far these may be regarded as reliable copies of earlier Greek pictures, or even to what extent they embody the 'essential features of lost originals', Professor Pfuhl and his translator are at variance. Against Professor Pfuhl's reasonable confidence we should place perhaps Professor Beazley's cautious conclusion that 'the originals must have differed profoundly from these copies or rather imitations'. And yet what power across the ages these imitations possess, that modern artists should be enthralled by them.

The bibliography has been extended and revized by Professor Beazley. There is a list of the artists who painted the Attic vases illustrated, and 160 illustrations, well-chosen and clearly reproduced, including four full-colour plates. Altogether a well-produced and stimulating book.

REGINALD G. HAGGAR

FROM THE JOURNAL OF 1856

VOLUME IV. *9th May*, 1856

From a letter On Taking Photographic Images Under Water.

Sir,

I enclose you a positive copy, from a negative collodion plate, of a view of a portion of Weymouth Bay, taken at a depth of three fathoms

The plan I adopted was very simple.

Mr. Kenyon, of this place, and myself, were weatherbound for a few hours at the Portland Ferry Bridge House, and in a room looking on the Fleet water, that was running like a mill-stream through the bridge, within thirty yards of our window.

I was musing, as persons in our then unfortunate condition (namely, weather-bound, and two miles from home and dinner) will muse; and my thoughts wandered to the effect the great force of the Fleet water would have on the piles of the bridge. I passed in review the piles carried away; and the diver's aid called in to examine the amount of submarine damage, and the difficulties and expense which necessarily follow; and the idea occurred to me that the camera might considerably assist us. . . .

I knew that, could we sink a glass plate, prepared with collodion, to the bottom of the sea, in theory there was no reason why we should not obtain as good an image as we do on land, provided the sea water could be kept from the camera, and that the light was sufficient. . . .

Following my idea, we made a box as nearly watertight as we could, and large enough to enclose the camera.

This box is fitted, in front with a piece of plate glass, and on the outside is a wooden shutter, heavily leaded, and which is raised by a string attached to it and communicating with the boat.

Up to the present point everything has been done on land. We now lash the whole of the apparatus, properly set, to the stern of the boat and, when we arrive at the proper spot, sink the camera. By means of the lowering rope we can find when the camera is upright at the bottom. When satisfied on this point, we raise the shutter in front of the camera box, by means of the string attached to it, and the other end of which communicates with the boat. The camera is now in action. . . .

With all my care, the great pressure at the depth to which I sank my camera forced the water into the camera itself, and covered the collodion plate. When I opened the camera and found it full of water, I despaired of having obtained a view; but it would appear that salt water is not so injurious as I had feared. I took the precaution of washing the plate gently with fresh water, and then of dipping it for an instant in the silver bath. The plate was exposed for ten minutes on an ordinary day in the month of February; it took nearly the same time to develop with pyro-gallic acid, using Horne and Thornwaite's collodion; you will see the negative is a weak one.

This application of photography may prove of incalculable benefit to science. We may take (to a reasonable depth) sketches of submarine rocks, piers of bridges, outlines of sandbanks, in fact, everything that is required under water. Should a pier of a bridge require to be examined, you have to suit your camera, and you will obtain a sketch of the pier, with any dilapidations; and the engineer will thus obtain far better information than he could from any report made by a diver.

WILLIAM THOMPSON

Some Activities of Other Societies and Organizations

MEETINGS

MON 14 MAY Chadwick Trust, at the Barnes Hall, Royal Society of Medicine, 1 Wimpole Street, W.1. 5 p.m. Huntingdon Williams: *The Influence of Chadwick on American Public Health.*

Electrical Engineers, Institution of, Savoy Place, W.C.2. 6 p.m. *An Elementary Presentation of the Principles of Magnetism and Electromagnetic Induction, with demonstration* (Discussion).

Geographical Society, Royal, South Kensington, S.W.7. 5 p.m. J. T. Hollin: *Oxford Expedition to North East Land 1955.*

TUES 15 MAY British Architects, Royal Institution of, at 66 Portland Place, W.1. 6 p.m. Henry Morris: *Architecture and the Local Community.*

Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. T. I. Green: *Mine Locomotives.*

WED 16 MAY Electrical Engineers, Institution of, Savoy Place, W.C.2. 5.30 p.m. R. L. Hearn: *The Sir Adam Beck Generating Station No. 2 at Niagara: A Major Canadian Hydro-Electric Development.*

Folk Lore Society, at University College, Gower Street, W.C.1. 7.30 p.m. T. C. Lethbridge: *The Giants of the Gogmagog Hills.*

THURS 17 MAY Textile Institute, at Cardiff University. 7.15 p.m. R. H. Wright: *Modern Textile Designs and their Production.*

WED 23 MAY Radio Engineers, British Institution of, at the London School of Hygiene and Tropical Medicine, Keppel Street, Gower Street, W.C.1. 6.30 p.m. K. Froome: *The Measurement of the Velocity of 'Light' by Electronic Methods.*

FRI 25 MAY British Sound Recording Association, at the Royal Society of Arts, W.C.2. 7.15 p.m. H. J. Houlgate: *A Description and Demonstration of the B.B.C. (Type DRD 5) Fine Groove Reproducing Desk, followed by a recital of unusual recordings from the B.B.C. archives presented by T. H. Eckersley.*

OTHER ACTIVITIES

NOW UNTIL 18 MAY Wood Engravers, Society of, at the Crafts Centre of Great Britain, 16–17 Hay Hill, W.1. *Exhibition of Wood Engravings and Colour Prints.*

NOW UNTIL 25 MAY The Building Centre, 26 Store Street, W.C.1. *Exhibition of Drawings and Cartoons for Stained Glass, Mosaics, Tapestries by Einar Forseth.*

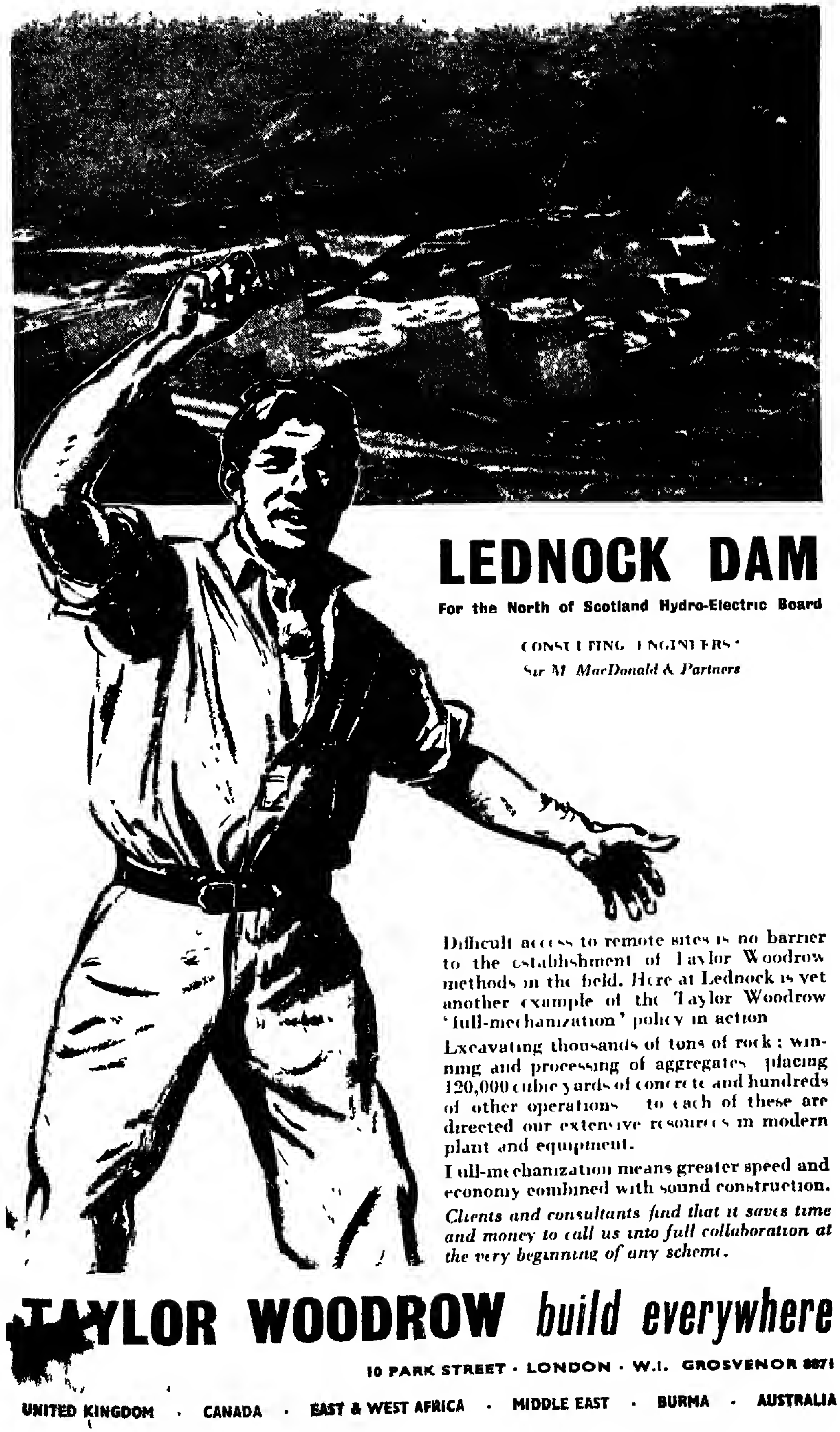
NOW UNTIL 26 MAY Contemporary Arts, Institute of, 17–18 Dover Street, W.1. Exhibition: *Roberto Burle Marx: Brazilian Landscape and Garden Design.*

NOW UNTIL 30 MAY Imperial Institute, South Kensington, S.W.7. Exhibition of Current Issues: *Commonwealth Postage Stamps.*

MON 14 MAY UNTIL SUN 20 MAY Imperial Institute, South Kensington, S.W.7. 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays. Films: *Hill Capital—Ceylon, Land of the Buddha: Ceylon.*

WED 16 MAY The Building Centre, 26 Store Street, W.C.1. 12.45 p.m. Film Show: *The Tubewright* (an introduction to Tubular Steel Engineering).

MON 21 MAY UNTIL SUN 27 MAY Imperial Institute, South Kensington, S.W.7. 12.30 p.m., 1.15 p.m. and 3 p.m. Weekdays, 3 p.m. and 4 p.m. Saturdays, 3 p.m., 4 p.m. and 5 p.m. Sundays (Whit Monday—times as for Saturday). Films: *African Journey: South and East Africa, The New India.*



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R.S.A. PUBLICATIONS

The following are some papers and lectures read to the Society in recent years Copies of the *Journals* in which they were published are obtainable on application to the Secretary Fellows are allowed a discount of 25 per cent Lists of titles of papers and lectures read in earlier years are also obtainable on application

THE SAFETY FACTOR IN CONSTRUCTION (Two Lectures) G A Gardner and Professor F S Thompson 2 6

THE NOVEL (Three Lectures) Dennis Wheatley Michael Joseph and Christina Foyle 3 6

THE KEMANO KITIMAT HYDRO ELECTRIC POWER DEVELOPMENT F L Lawton 2 6

THE ASCENT OF EVEREST Wilfrid Noyce 2/6

WEATHER MODIFICATION AND ITS VALUE TO AGRICULTURE AND WATER SUPPLY Dr Irving P Krick 2

SAFETY IN TRANSPORT (Three Lectures) Dr W H Glanville Sir Vernon Brown and Lieut - Colonel G R S Wilson 3

COLOUR TELEVISION BROADCASTING C G Mayer 2

THE DESIGN OF NEW SCHOOLS C H Aslin

LETTER DESIGN AND TYPECUTTING Harry G Carter 2

LIFE IN THE YEAR 2000 A D Two prizewinning essays

SCIENCE AND FOOD PRODUCTION Dr L Lampitt

RESEARCH IN THE COAL INDUSTRY Dr Idris Jones

THE COPPERBELT OF NORTHERN RHODESIA R L Prain

TSETSE FLY CONTROL Dr K R

MUSIC (Three Lectures)—IN EDU Greenhouse Allt, —IN THE THEA Bridgewater, —IN MEDICINE F 3

VIRUS DISEASES OF PLANTS F C Bawden 2

THE ROYAL SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES AND COMMERCE

PATRON: HER MAJESTY THE QUEEN

Full particulars relating to the work of the Society and conditions of membership and associate membership may be obtained from the Secretary.

The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

All other communications for the Society should be addressed to THE SECRETARY, [illegible] IETY OF ARTS, 6–8 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2. Te[illegible]e number: Trafalgar 2366. Telegrams: Praxiteles, Rand, London.

Journal of the Royal Society of Arts

NO. 4978 25 MAY 1956 VOL. CIV

LONDON
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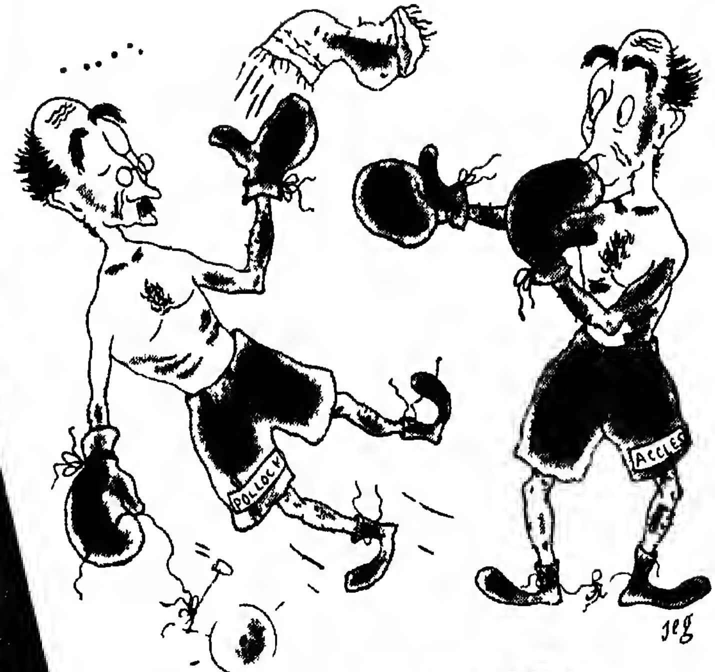
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Journal of the Royal Society of Arts

NO. 4978 | FRIDAY, 25TH MAY, 1956 | VOL CIV

FORTHCOMING MEETINGS

MONDAY, 28TH MAY, at 6 p.m. The last of three CANTOR LECTURES on '*Some Recent Studies of Sociology*', entitled '*Changes in Social Responsibilities*', by Roger F. Tredgold, M.A., M.D.

TUESDAY, 29TH MAY, at 5.15 p.m. COMMONWEALTH SECTION. NEIL MATHESON MCWHARRIE LECTURE. '*The Theatre and Ballet in Canada*', by Robert Speaight, M.A., F.R.S.L. His Excellency Mr. Norman A. Robertson, High Commissioner for Canada, will preside. (Tea will be served from 4.30 p.m.)

WEDNESDAY, 30TH MAY, at 2.30 p.m. '*Examinations: Do We Still Need Them?*', by Sir Griffith Williams, K.B.E., C.B., a Member of the Council of the Society, and former Deputy Secretary, Ministry of Education. Sir Edward Crowe, K.C.M.G., a Vice-President of the Society and Chairman of its Examinations Committee, will preside.

WEDNESDAY, 6TH JUNE, at 2.30 p.m. '*The Influence of National Character on Design*', by Paul Reilly, Deputy Director, Council of Industrial Design. John Gloag, Hon.A.R.I.B.A., a Member of Council of the Society, will preside. (The paper will be illustrated with lantern slides.)

Fellows are entitled to attend any of the Society's meetings without tickets (except where otherwise stated), and may also bring two guests. When they cannot accompany their guests, Fellows may give them special passes, books of which can be obtained on application to the Secretary.

INDUSTRIAL ART BURSARIES EXHIBITION

Fellows who were unable to visit the Society's Industrial Art Bursaries Exhibition, which closed on 18th May, are reminded that the designs are now on view at the Production Exhibition at Olympia, which is open from 10 a.m. to 5 p.m. on weekdays, including Saturdays, until 31st May.

As was announced in the *Journal* for 13th April, tickets for group visits to this Exhibition are available at reduced rates upon application to the Exhibition organizers.

LEGACY FROM THE LATE MRS. N. W. MICHAEL

A legacy of £1,000 has been received by the Society from the estate of the late Mrs. N. W. Michael. The terms of the bequest are as follows:

> I BEQUEATH to the Treasurer for the time being of the Royal Society of Arts of John Adam Street Adelphi W.C.2 in the County of London the sum of £1000 free of any duty payable by reason of my death to be invested by him in any investment from time to time sanctioned by law for the investment of trust funds upon trust to apply the income thereof in the purchase of such books as the Council for the time being of the said Society may in their absolute discretion decide to the value of the said income to be placed in the Library of the said Society to be used by all members thereof AND I DESIRE that this bequest shall be known as *The Fred Henry Andrews Bequest* AND I DECLARE that the receipt of the Treasurer for the time being of the said Society shall be a full discharge to my Trustees in respect of the same.

Mrs. Michael was the daughter of Mr. F. H. Andrews, who has been a member of Council for many years, having been first elected a Vice-President of the Society in 1935, since when he has served almost without intermission.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 14th May, 1956. Present: Dr. R. W. Holland (in the Chair); Dr. W. Greenhouse Allt; Sir Alfred Bossom; Sir Edward Crowe; Mr. Robin Darwin; Mr. P. Le Neve Foster; Sir Ernest Goodale; The Earl of Halsbury; Mr. A. C. Hartley; Mr. William Johnstone; Lord Latham; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. O. P. Milne; Lord Nathan; Mr. E. Munro Runtz; Sir Harold Saunders; Sir Selwyn Selwyn-Clarke; Sir John Simonsen; Sir Stephen Tallents; Sir Griffith Williams, and Mr. J. H. Wilson; with Mr. K. W. Luckhurst (Secretary), Mr. R. V. C. Cleveland-Stevens (Deputy Secretary) and Mr. David Lea (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Behrens, Edgar Charles, C.B.E., J.P., Ilkley, Yorks.
Berry, John Arthur, A.T.D., London.
Beytagh, Dennis, Wellington, New Zealand.
Cavill, Miss Marjorie Thirza, Upminster, Essex.
Dawson, Arthur, A.C.I.S., Richmond, Yorks.
Dearden, Derek Walter, Huddersfield, Yorks.
Founds, Charles Frederick, Calgary, Alberta, Canada.
Gardner, Jack, London.
Gibson, Neil, Glasgow.
Gummerson, George Kenneth, Edinburgh.
Hines, Vivian Gerald, J.P., Colchester, Essex.
Khan, Malik Akbar Ali, London.
Lovrey, Raymond Donald, London.
Main, Douglas William Victor, B.A., Kuala Lumpur, Malaya.
Miller, Andrew Gardner, F.I.B.D., Lanark.
Minter, James George, F.A.C.C.A., London.

Monk, William George, Enfield, Middx.
Parker, David, L.R.A.M., Ipswich, Suffolk.
Parker, William Neave, Twickenham, Middx.
Pell, Horace, A.M.I.Mech.E., London.
Rao, D. Subba, M.B., B.S., B.S.Sc., M.P.H., Nungambakam, Madras, India.
Sanderson, Gordon Murray, Edinburgh.
Sherek, Henry, London.
Tristram, Mrs. Alwyn, Des.R.C.A., Brierley Hill, Staffs.
Wanless, Thomas Bellamy, Durham, Co. Durham.
Warner, Andrew Roderick, Glasgow.
White, Kenneth Charles, London.
Whitehouse, Patrick Bruce, Birmingham.
Williams, David John, M.A., B.Sc., Lancaster, Lancs.

The following was duly elected an Associate Member as a winner of an Industrial Art Bursary in 1955:

Howard, Miss Shirley, Manchester.

The following were admitted as Institutions in Union under Bye-Law 66:

The Central Association of Photographic Societies.
The Spalding Gentlemen's Society

ALBERT MEDAL

Further consideration was given to the award of the Albert Medal for 1956 and a name was selected for submission to His Royal Highness the President.

CHAIRMAN OF COUNCIL, 1956-57

Dr. R. W. Holland was nominated to serve as Chairman of the Council for the year 1956-57.

BALLOTING LIST, 1956-57

The Balloting List for the new Council was prepared for the Annual General Meeting.

'BEAUTY IN DANGER'

It was decided to appoint a Committee, with Sir Stephen Tallents as Chairman, to advise the Council regarding possible action to follow up the recent lectures on 'Beauty in Danger'.

EXAMINATIONS

It was reported that 47,167 entries had been received for the Whitsun series of Examinations.

EVENING DISCUSSION MEETINGS

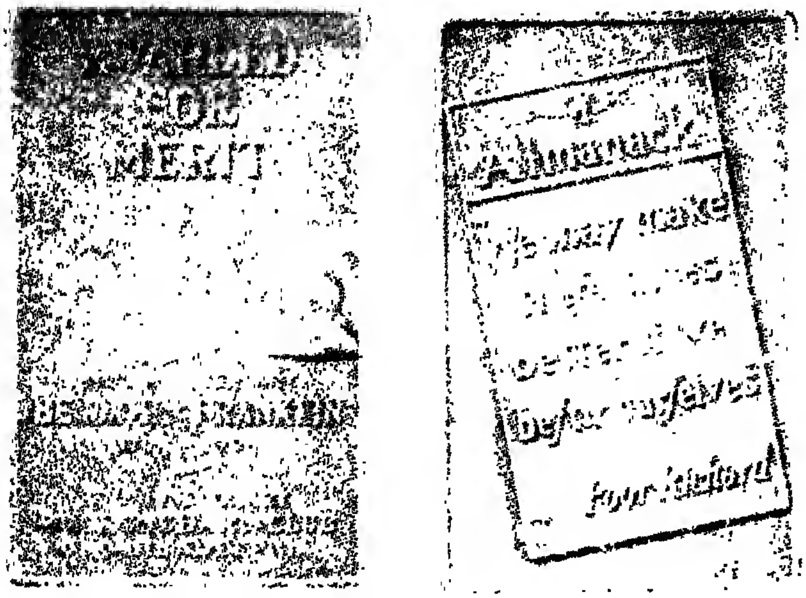
On the advice of the Special Activities Committee, it was decided that the response to the series of Evening Discussion Meetings arranged during the present session did not warrant the arrangement of a similar series next session.

OTHER BUSINESS

A quantity of financial and other business was transacted.

PRESENTATION OF THE POOR RICHARD ALMANACK MEDAL

At an informal ceremony in the Society's House on 15th May, Mr. Kenneth W. Luckhurst, Secretary of the Society, was presented with the Poor Richard Almanack Medal and Diploma 'For Distinguished Service', by Walter D. Fuller, Chairman of the Board of the Curtis Publishing Company of Philadelphia. Dr. R. W. Holland, Chairman of the Council, Mrs. Fuller, Mrs. Luckhurst and the Deputy Secretary were present. The award was made to Mr. Luckhurst by the Poor Richard Club of Philadelphia in recognition of his contributions, and in particular his address to the Club last year, to the celebration of the 250th anniversary of the birth of Benjamin Franklin.



The Poor Richard Almanack Medal, bearing obverse: *the head of Benjamin Franklin; and* reverse: *a quotation from Poor Richard's Almanack*

Mr. Fuller is himself linked with Benjamin Franklin, both as publisher of the *Saturday Evening Post*, which was founded by Franklin, and as descendant of Anne Franklin, his sister, and after the presentation he and Mrs. Fuller were shown the various letters received by the Society from Benjamin Franklin, and references to him in the Minute books.

RECENT DEVELOPMENTS IN TRADE AND INDUSTRY IN PAKISTAN

The Henry Morley Lecture by

HIS EXCELLENCY MR. MOHAMMED IKRAMULLAH,

High Commissioner for Pakistan, *delivered to the Commonwealth Section of the Society on Thursday, 8th March, 1956, with the Right Honble. Lord Hailey, P.C., G.C.S.I., G.C.M.G., G.C.I.E., in the Chair*

THE CHAIRMAN: I should begin by a reference to the fact that Mr. Morley, the founder of the Henry Morley lectures, was for nearly sixty years a life Fellow of the Royal Society of Arts. He was Secretary of the Royal Niger Company and it is natural that the lectures which his bequest inaugurated should deal with matters affecting the British Empire and should deal primarily with its economic interests. It is to subjects of this character that His Excellency the High Commissioner will consequently address himself and not to the political issues which now form some source of difference between India and Pakistan. But the economic position of Pakistan is a matter of the greatest concern to all who have had relations in the past with that country or who have a present interest in its welfare.

The following lecture was then delivered:

THE LECTURE

Pakistan is barely eight years old. At the beginning, her economy was mainly agricultural. Raw materials like jute, cotton, wool, tea, hides and skins constituted 99 per cent of her exports; and she had to import almost all the manufactured goods. Industry in the two wings of Pakistan was practically non-existent. Therefore it was but natural for the Government of Pakistan to give the highest priority to the preparation of a development programme so as to give the country a balanced economy.

In the period from 1948 to 1950 a Development Board examined and approved various projects in such fields as agriculture, industry, power, communications, and health on an *ad hoc* basis. During the second half of 1950, however, these projects were integrated into a national development programme known as the Six Year Plan. It was to cover the period from July, 1951, to June, 1957. The basic objectives of this comprehensive plan were (1) a net increase of £60 million sterling in the country's foreign exchange earnings; (2) an increase of £7¼ million per year in Government's revenues; and (3) a thirty per cent rise in the standard of living. The Six Year Development Plan was originally estimated to involve an expenditure of £195 million of which £105 million was internal expenditure; out of the estimated internal expenditure £30 million was to come from private enterprise.

Thirty-two per cent of the total expenditure under the plan was earmarked for the development of agriculture. Projects included irrigation, land settlement, anti-waterlogging measures, improvement in seed varieties, subsidization of chemical fertilizers, purchase of agricultural equipment, improvement of livestock, and development of fisheries.

In order to diversify the essentially agrarian economy, 19 per cent of the total expenditure under the plan was set aside for the development of industry and mining. The plan included the establishment of five jute mills in East Pakistan with a total of 6,000 looms, 24 cotton textile mills of 25,000 spindles each and a paper mill near Chittagong in East Pakistan.

Expenditure on power and fuel was estimated at 18 per cent of the total. Major projects were the Warsak Project in the North-West Frontier, the Mianwali Project in the Punjab, and the Karnafuli Project in East Pakistan. Coal output was to be increased to more than 800,000 tons per year.

Perhaps the most ambitious project in the field of transport and communications was the development of the Port of Chittagong, at a cost of £9½ million. The handling capacity of Chittagong at partition, 600,000 tons per year, has already been increased to 1,800,000 tons per year. The construction of additional jetties was entrusted to a British firm. The goal for 1957 is considerably higher.

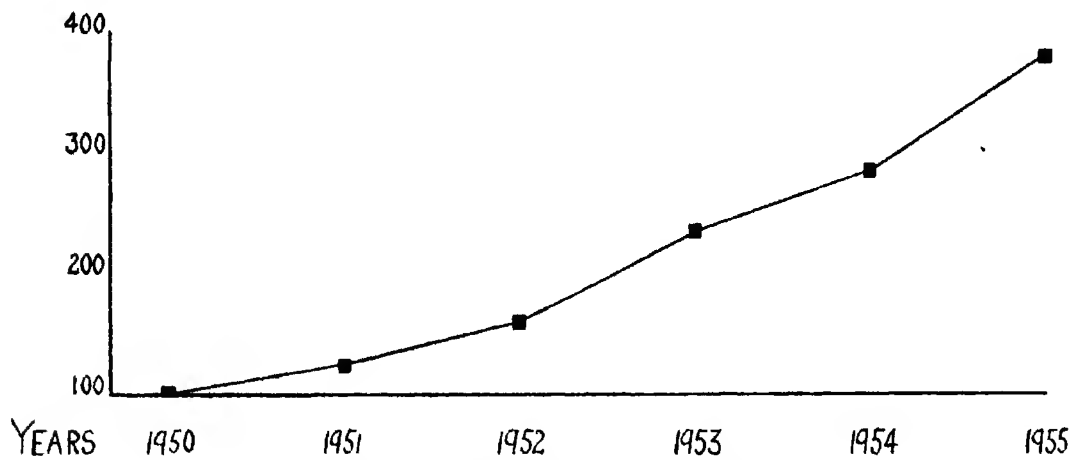


FIGURE 1. *Pakistan index of industrial production. Survey of major industries*

In March, 1951, the Government of Pakistan drew up a special two-year programme designed to give priority to those projects which would make the country self-sufficient in regard to its basic requirements. This step, necessitated by an extreme shortage of capital goods, was taken in the wake of the increase in foreign reserves of the Government resulting from the Korean War boom. Particular attention was given in this programme to the transport and communications industry, and to the development of thermal power to meet the ever-increasing power demand until the full supply became available on completion of long-term hydro-electric projects.

Against this background of development in the fields of agriculture, power and communications, the establishment of industries based on Pakistan's indigenous

raw materials has progressed steadily, and as fast as circumstances have permitted up to the limits suggested by the Development Board. If we take the year 1950 as base year, with the index of industrial production at 100, a rough survey of the production of 17 major industries indicates the corresponding indices at 125 for 1951, 160 for 1952, 235 for 1953, 285 for 1954, and 380 for 1955. The indigenous production of cloth and yarn in 1954 reached 483,000 bales as against 301,000 bales in 1953 and only 108,000 bales in 1950. There has thus been an increase of 347 per cent during the period from 1950 to 1954. The rise in production in the case of other industries during the same period was 130 per cent in sugar, 175 per cent in hydrogenated vegetable oils, 208 per cent in cigarettes, 473 per cent in upper leather, 284 per cent in leather soles, 804 per cent in safety matches,

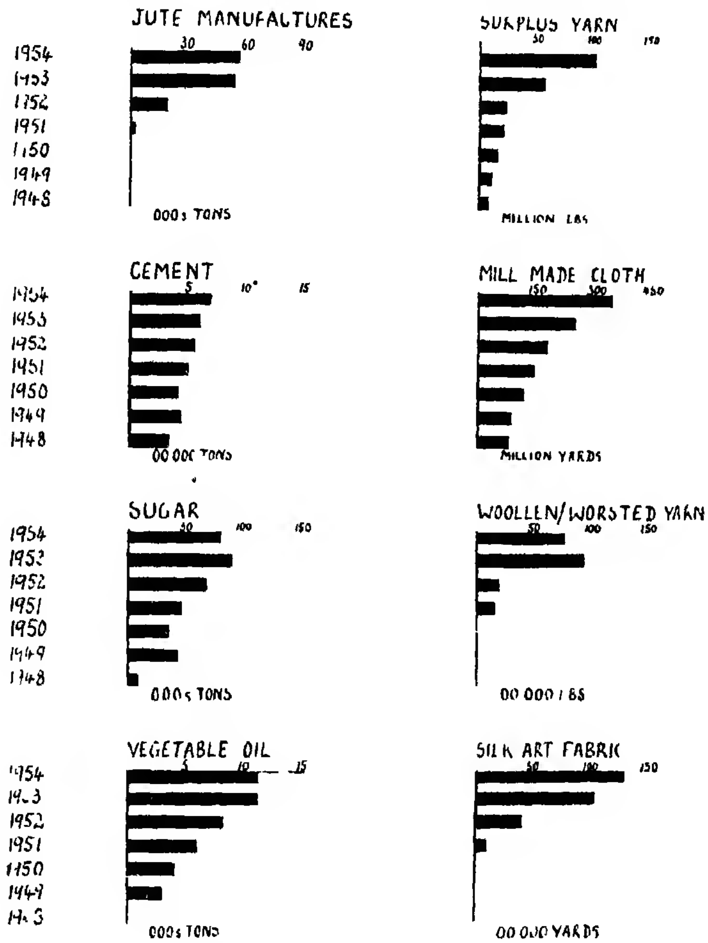


FIGURE 2. *Pakistan industrial production, 1948 to 1954*

52 per cent in crude petroleum, 53 per cent in petroleum products, 63 per cent in cement, 169 per cent in steel ingots and steel re-rolling, 27 per cent in coal and 173 per cent in electric energy. The country is now self-sufficient in coarse and medium varieties of cloth and woollen goods, except worsted fabrics of finer quality. The jute industry, after meeting the country's requirements in full, has already entered the foreign market and 11,000 tons of hessian and

sacking were exported during 1954. The national income originating from large-scale manufacturing industry increased by 34 per cent between the years 1949-50 and 1952-53. The number of manufacturing establishments as defined in the Factories Act increased from 1,800 in 1953 to 2,751 in 1954.

The Government of Pakistan appointed a new Planning Board in 1954 to review the progress which had been achieved so far in order to re-assess the overall resources of the country and to prepare a comprehensive plan of development for the next five years. The new Five Year Plan has been prepared and is under consideration by the Government departments concerned. Meanwhile, the conclusions of the Planning Board, as embodied in their plan, have been taken into account in framing the programme of development in the public sector for 1955-56, which is the first year of the Five Year Plan period.

The most outstanding achievement in the field of industrialization so far has been the manufacture of cotton textiles. The installed capacity already approximates to 1¾ million spindles and 25,730 looms. This, as compared with the 177,418 spindles and 4,824 looms which the country had at the time of partition, provides a measure of the progress which has been made in the cotton textile industry. In view of the self-sufficiency attained in the coarse and medium varieties of cloth, attention now is being increasingly devoted to the production of fine and superfine cloth and to the increase of facilities for dyeing and printing.

Nor has the handloom industry been neglected. Supply of yarn to it is being assured in increasing quantities out of indigenous production. At present a fact-finding committee has been set up to inquire into the problems of the industry and to suggest measures for protecting and sustaining it.

At the time of partition, there was no woollen mill in Pakistan. Now eight mills comprising 22,760 woollen and 21,832 worsted spindles are in operation. Two of these mills have been sponsored by the Pakistan Industrial Development Corporation, which has also placed orders for a third mill to be set up at Qaidabad in the Thal area. Adequate capacity for weaving almost all varieties of art silk fabrics has also been established.

The progress of the jute industry has been no less significant. This industry, in which the P.I.D.C. has provided the initiative and a sizeable part of the finance, owes its rapid progress in no small measure to the participation of private enterprise. Private enterprise has contributed nearly two-thirds of the total capital invested so far, amounting approximately to £12·7 million. It has also provided almost the entire managerial and technical personnel required. The target of 6,000 looms was attained by the middle of 1955—much earlier than the date envisaged by the Development Board. The programme for further extension by the addition of 1,500 looms is well under way, and provision for another 1,500 looms is under consideration. The 6,000 looms already installed have a production capacity of 200,000 tons of jute goods per year, valued at £16½ million. The domestic requirements of the country are only 40,000 tons.

The Karnaphuli Paper Mill in East Pakistan, costing about £4½ million to build went into partial production in 1953 and is now in full production turning out 30,000 tons of paper worth about £2¼ million per annum. The mill is

now able to meet the requirements of the country for various types of paper other than newsprint. The P.I.D.C. has under examination the question of installing another mill in East Pakistan at a cost of £4½ million and capable of producing 30,000 tons of newsprint per annum. The two board mills at Nowshera and Rahwali, costing £2¼ million, have been completed and are in production. They will produce about 15,000 tons of paper board per annum in the initial stage.

In order to bridge the gap between the supply and demand of cement, two cement factories, one at Daudkhel and the other at Hyderabad, called the Zeal-Pak Cement Factory which started production in January, 1956, have been constructed. The total capacity of these two factories will be 340,000 tons a year. The Daudkhel factory started production in the third quarter of 1955. The Chattak factory in East Pakistan is expected to raise its production from 50,000 tons per year to 75,000 tons per year by the middle of 1956.

In addition to the eight existing factories producing 1½ million fire bricks against the installed capacity of 3·6 million per year, two other factories, one at Malakwal in the Punjab and the other at Landhi near Karachi, are under construction. With their completion, the requirements of the country for most of the refactories will be largely met from indigenous sources.

Investigations have been carried out through the well-known German firm of Krupps— with whom P.I.D.C. entered into a ten-year agreement in 1953 for the setting up of an Iron and Steel Industry in Pakistan. These investigations have established the existence of sufficient quantities of iron ore in the Punjab and in the N.W. Frontier and a scheme for the establishment of an integrated iron and steel plant has been approved. The first phase of the Krupps-P.I.D.C. plan envisages the setting up of a pilot plant at a cost of £7½ million with a production capacity of 50,000 tons of iron ingots. The initial scheme includes two rolling mills with an annual capacity of 115,000 tons of bars, shapes, rods and hoops, and 86,000 tons of sheets and tin plate. Under the second phase of the scheme a plant with the capacity of 300,000 tons of steel ingots and 50,000 tons of pig iron per annum will be installed. The cost of the entire plant is estimated at £19½ million, of which Krupps will subscribe ten per cent and the rest will be contributed by the P.I.D.C.

The two caustic soda plants sponsored by the P.I.D.C., one at Nowshera and the other at Chandragona, having a total capacity of twenty tons per day, have already gone into production. The D.D.T. plant provided by the World Health Organization and the United Nations International Children's Emergency Fund, having a capacity of 700 long-tons of hundred per cent D.D.T. per year, has also been established at Nowshera. In addition to the ten-ton sulphuric acid plant which is under private management in Karachi, two sulphuric acid plants have been sponsored by the P.I.D.C., one at Chandragona and the other at Lyallpur. The Lyallpur plant will convert a large part of its production into super-phosphate and is expected to produce some 6,000 tons of super-phosphate every year. A 50,000-ton ammonium sulphate plant is being established at Daudkhel in the Thal and is likely to commence production by the middle of

1956. The plant, which is estimated to cost £4 7 million, is being financed by the Foreign Operations Administration in respect of the external expenditure involved.

The P.I.D.C. has sponsored schemes for the development of the Karachi Ship Repair Yard, the Karachi Dock Yard and the Khulna Dock Yard. By the time it is completed this year, the Karachi Ship Repair Yard Scheme, which incorporates the commercial dry dock, will have cost £3 million. The main function of the dockyard is to provide repair facilities, but it will also be possible to construct ships of 3,000 dead weight tons. The second phase of the scheme, costing £2¼ million, envisages the building of ships up to 12,000 dead weight tons and is planned to be completed by the middle of 1957. The Khulna dockyard scheme aims at meeting the requirements of inland water transport in East Pakistan, both for repairs and dry-docking. Under this scheme, it is proposed that the Khulna shipyard with its seven slip-ways and the Narayangunj shipyard, which is specially equipped for undertaking repairs to diesel engines, should be dovetailed. The cost of the revised project is estimated at £1½ million.

Although considerable progress has been made in the production of sugar, it has not yet been possible to meet more than a third of the requirements of the country from indigenous sources. Two sugar mills with a total capacity of 24,000 tons per annum have recently gone into production at Jauharabad and Leiah in the Thal area. Two others with a total capacity of 44,000 tons a year, one in Charsadda in the N.W. Frontier and the other in Rangpur in East Pakistan, are expected to go into production by the end of this year.

Arrangements have now been made for the manufacture of metal containers to meet the requirements of processed food industries. Two large-sized modern automatic units for the production of glass containers are also being established. With the availability of containers assured, the processed food industry is expected to make considerable progress. There are now over a hundred factories, engaged in the production of edible oils from locally grown oil seeds like cotton, rape, mustard and sesamum. The production of edible oils is increasing.

Other important industries which have registered progress are matches, machine tools, tanning and leather, paints, varnishes, dyes and pharmaceuticals. There are 14 match factories in the country now, producing 2·4 million gross boxes, as against less than half a million gross boxes of fifty sticks each from eight match factories in 1948. Substantial progress has also been registered in the cigarette making industry. The present production is 5,000 million. It is estimated that within the next two years their annual production will reach the figure of 10,000 million. There are 46 tanneries, some fully and some partially mechanized, with a total annual production capacity of 17 million pounds of soles and 17 million square feet of uppers. The newly established industry manufacturing tyres is now meeting the country's total requirements of cycle tyres and tubes. The P.I.D.C. is sponsoring the establishment of a dyes factory at a cost of £300,000. It is expected to go into production by 1957. The P.I.D.C. has also taken up the development of the pharmaceutical industry, and has re-started the manufacture of santonin. A penicillin plant is being set

up at Nowshera with the assistance of U.N.I.C.E.F. Messrs. Glaxo Laboratories (Pakistan) Ltd. have set up a factory at West Wharf, Karachi, for the manufacture of drugs and antibioties which started production in January, 1956. A number of other industries, manufacturing consumer goods such as soap, shoe polish, tooth paste, hair oils, cosmetics, pencils, gramophone records, radio sets, sewing machines, and so forth, have made good progress.

In addition to large-scale industries, there is a great scope for the development of cottage and small-scale industries which cover a wide productive field with a broad employment base. These industries are particularly suited for the better utilization of local resources and for the production of a variety of consumer goods for the internal market as well as for export. The Government has established a Small Industries Corporation which will develop overseas and inter-regional trade in cottage industries products. The Government has also decided to establish two Small Industries Development Corporations, one for West Pakistan and the other for East Pakistan, to assess and promote the production and marketing of cottage products within each region. An Industrial Development-*cum*-Research Centre for small industries has been established at Lahore in collaboration with the International Co-operation Administration and a similar centre is being established at Dacca.

The development of power has proceeded satisfactorily. In East Pakistan, the diesel stations at Sidhirganj, Khulna and Chittagong, with a total capacity of 38,000 kilowatts have been completed. Another 30,000 kilowatt steam station at Sidhirganj is being planned. Work is also in progress on the Karnaphuli Hydro-electric Project and, according to the present programme, the first set of 40,000 kilowatts will be commissioned by 1958. In West Pakistan, the Lyallpur diesel station of 10,000 kilowatts capacity is nearing completion and another 6,000 kilowatt set is also being established there. A 132 kilowatt transmission line between Wah and Jhelum with a route length of 116 miles has been completed. The Dargai Project in the N.W. Frontier, with an installed capacity of 20,000 kilowatts, has been commissioned into service. In Karachi, work on the 30,000 kilowatt steam station is nearing completion. The former Sind Government sponsored a project of a 15,000 kilowatt station at Hyderabad. The multi-purpose Warsak Project, which will have an installed capacity of 160,000 kilowatt sets, is expected to be in operation in 1958. The external expenditure on this project is being financed from the aid given by the Canadian Government under the Colombo Plan.

At the time of partition, there was an installed capacity of nearly 61,000 kilowatts of thermal power and 11,000 kilowatts of hydro-electric power. It has now risen to 197,000 kilowatts of thermal power and 63,000 kilowatts of hydro-electric power. With a view to accelerating the development of power resources still further, the Government is considering the question of establishing statutory electricity authorities for the operation of power undertakings on sound commercial lines.

There has been a steady rise in the production of coal which has gone up from 241,000 tons in 1948 to 554,000 tons in 1954. The production of oil has increased

FIGURE 3. *A Bugti flute player and Sui Gas Well No. 2*

from 500,000 barrels in 1948 to 1,800,000 barrels in 1955. Search for more oil in both zones of the country continues. An agreement has been signed with the Standard Vacuum Oil Company providing for a joint venture for oil exploration at a total cost of £15 million, of which 25 per cent will be provided by Government funds. Negotiations are in progress with a number of other oil interests for further exploration of the country's oil resources.

The year 1952 witnessed an event of profound significance for the economy of Pakistan. This event was the discovery of a vast reservoir of natural gas at Sui in Baluchistan by Pakistan Petroleum Ltd.—a British firm. Expert geologists have estimated that this reservoir contains over 2¼ million million cubic feet of natural gas which represents a supply of 115 million cubic feet per day for over a century. Work at the Sui gas field was started in 1954 and six wells have already been completed. A re-assessment of the reserves is in progress and, on present indications, it is likely that the total size of the reserves may turn out to be much

greater than the original estimate. The project of bringing gas from Sui to Karachi *via* Sukkur and Hyderabad was completed in September, 1955. The initial rate of production will be 37 million cubic feet a day rising progressively in a few years to three times this quantity. The question of taking the gas north from Sui for the generation of electricity is under consideration. The P.I.D.C. are sponsoring the establishment of a 100,000 kilowatt power station.

Hitherto the industrial and agricultural development of Pakistan was hampered by the meagre supply of indigenous fuel in the country. The estimated total production of coal, all in West Pakistan, is some 600 000 tons per year whereas the total consumption of coal in West Pakistan alone is about 1 200,000 tons per year. The balance of 600,000 tons has to be met by the import of foreign coal. Similarly, crude oil is produced only in West Pakistan and amounts to 200 000 tons per year. Of this some 76,000 tons represents furnace oil. The actual consumption of furnace oil in West Pakistan is over 600 000 tons per year most of which has to be imported from abroad. With the availability of gas in large areas of West Pakistan from this year for industrial as well as domestic purposes, Pakistan can dispense with large imports of furnace oil, thus saving very substantial amounts of foreign exchange. The gas at Sui is natural gas which is the most convenient form of fuel nature has provided. It is an ideal fuel for steam power plant installations and is likewise a convenient fuel for internal combustion engines and gas turbines of all sizes. In addition it is an excellent raw material for the chemical industry and can easily be utilized for manufacturing synthetic fertilizers in order to increase home production of foodstuffs.

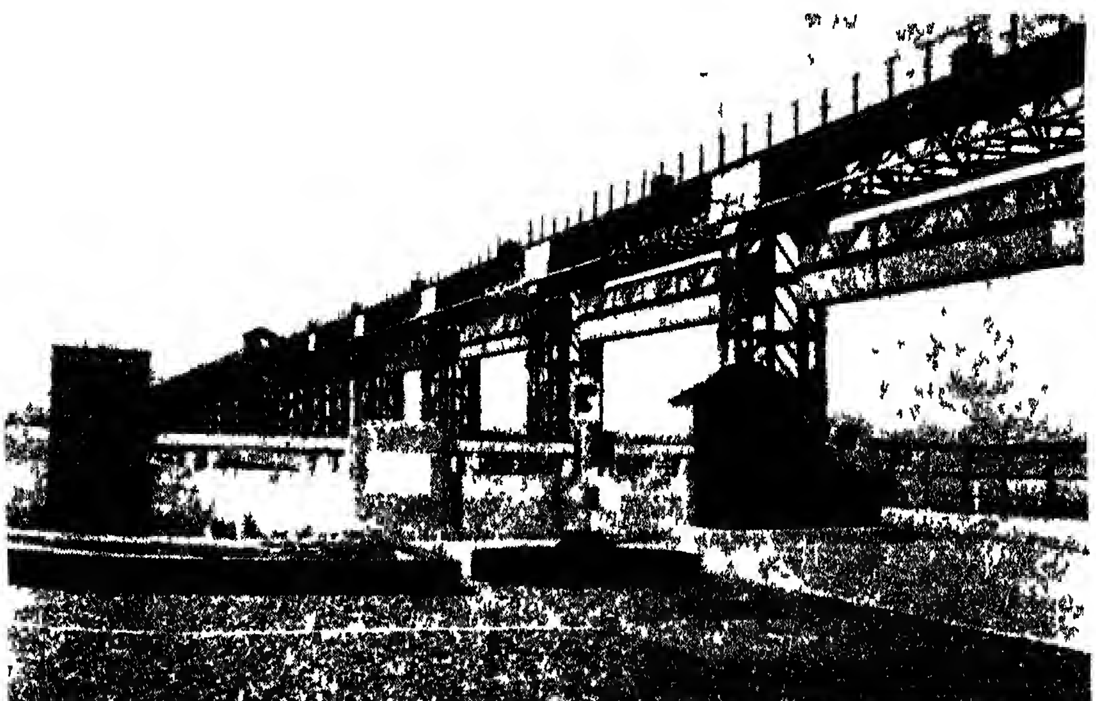


FIGURE 4 *Thal irrigation project, the Jinnah barrage*

The growth of industry in Pakistan, taken together with significant developments in the fields of agriculture, irrigation, communication and power, has had far-reaching effects on the economy of the country. There have been many set-backs and difficulties in the past and there may be some more in the future. The remarkable thing is that, in spite of these difficulties and set-backs, the Government of Pakistan, as well as private investors, has continued to go forward at a speed greater than that envisaged by the most optimistic planners. This progress is illustrated by the fact that in the last five years expenditure in the public sector has been to the tune of £276 million. The annual expenditure on development increased from £31 million in 1951–52 to £83 million in 1955–56. In the private sector over £150 million were invested. The P.I.D.C., which has completed 16 industrial projects with a capital expenditure of £25 million, is expected to complete another 17 projects costing about £30 million in the next financial year. Already Pakistan is regarded as a semi-industrialized country and her economy, which was purely agricultural in 1947, has passed from instability to a position of growing strength.

This change from an agricultural to a semi-industrialized economy is changing the pattern of Pakistan's foreign trade. How far-reaching the effect of industrialization has been on our trade can be gauged from the fact that the import of cotton piece goods dropped from £27·6 million in 1951–52 to a mere trickle at £2·7 million by 1954–55. Similarly, cotton twist and yarn came down from a figure of £19·3 million to only £2·1 million in 1954–55.

The foreign exchange saved as a result of reduced imports of cotton piece goods and yarns has been used for the purchase of much needed machinery and other capital equipment. On the other hand, the volume of our exports in raw materials has, in most cases, been maintained at much the same level as was reached in 1951–52, although the value of this trade in some cases is much lower because of the recession in prices. The dependence of Pakistan, mainly on a few raw materials, has tended to impede the expansion of her export trade. In order to stimulate the export of other articles so that the trade may become as broad-based as possible, the export policy has been considerably liberalized. Government also introduced the Export Incentive Scheme, which provided for the issue of import licences to exporters to the extent of twenty to thirty per cent of the total exchange earned by exporters of selected primary commodities and manufactured goods. This scheme, on the one hand, stimulated the export of minor commodities which had been neglected so far and, on the other, solved the problem of financing the import of certain essential goods. It has also helped to stimulate the development of small-scale industries. It has recently been superseded by the new Export Promotion Scheme which has the same objectives as its predecessor but has a wider scope.

The Government of Pakistan has been conscious of the fact that the stability of the country's economy can best be assured by diversifying her overseas trade, which obviates the risks inherent in dependence on one or two countries. Bilateral trade agreements have, therefore, been concluded with a number of countries. In 1948–49 only four countries, namely the United Kingdom, the

United States, India and China had trade with Pakistan exceeding £7½ million in value. By 1954-55 the number of such countries rose to six, namely, the United Kingdom, the United States, Japan, Germany, India and France. Pakistan's total trade with the world fell from £186·9 million in 1949-50 to £174·4 million during 1954-55. Of this total, India's share fell from £36·4 million in 1949-50 to £15·4 million in 1954-55. With the rest of the world, however, trade increased continuously from £150 million in 1949-50 to £159 million in 1954-55. This increase was due not only to the favourable prices of Pakistan's exports in raw materials but also to an increase in the volume of the country's imports and exports. The total world trade of Pakistan in 1949-50 amounted to £186 million of which exports were valued at £89 million and imports at £97 million. In 1954-55 the total value of trade was about £174 million of which exports stood at £91·7 million and imports at £82·7 million.

The number of Pakistan's major customers in 1948-49 whose imports from Pakistan exceeded £4 million was four, namely the United Kingdom, the United States, Belgium and Germany. In 1953-54 the number of such customers rose to nine, namely the United Kingdom, the United States, Japan, France, Germany, China, Italy, Belgium and Hong Kong. During 1948-49 India was the principal supplier and customer of Pakistan; but her position in Pakistan's foreign trade has been changing continuously and, by 1953-54 her share amounted to only nine per cent.

Pakistan's import policy has always been influenced by her balance of payments position. Up to November, 1952, the import of capital goods and machinery was kept on Open General Licence to facilitate industrialization and other development projects. Thereafter, this policy was abandoned owing to the steep fall in the earnings of foreign exchange caused by the post-Korean slump in commodity prices. Now all imports into Pakistan are licensed, but special consideration is shown to imports of machinery and materials intended for industrialization. The restrictions on imports were, however, relaxed when United States aid was received at the beginning of 1955. With an improvement in the foreign exchange earnings, and progress in industrialization, it should be possible to relax restrictions on imports still further.

Pakistan has received considerable assistance from the United Kingdom, the United States, Canada, Australia, New Zealand and other friendly nations in implementing her development programme. We are very grateful for this timely assistance but we still need assistance and would welcome foreign capital seeking investment. When the Government of Pakistan issued its statement of industrial policy on 2nd April, 1948, it extended this invitation to investors all over the world. Certain conditions were laid down at the time governing the investment of foreign capital. The position has since been reviewed in the light of experience gained in the last eight years and Government has decided to offer the following additional facilities as further incentives to non-Pakistani investors:

(1) Capital invested in industries after 1st September, 1954, in projects approved by the Government of Pakistan, may be repatriated at any time

thereafter to the extent of the original investment to the country from which the investment originated.

(2) Any part of the profits derived from investment and ploughed back into approved industrial projects with the approval of the Government of Pakistan may be treated as investment for the purpose of repatriation.

(3) Appreciation of any capital investment under (1) and (2) above may also be treated as investment for repatriation purposes. In the case of investment by means of goods and services the amount will be the rupee value of such goods or services as recorded in the books of the company or firm concerned at the time of investment.

(4) Such repatriation facilities will be subject to exchange control regulations as are in force from time to time and will not apply:

(*a*) to purchase of shares on the Stock Exchange unless it is an integral part of an approved investment project, and

(*b*) to capital invested in Pakistan before 1st September, 1954.

The Government has also given an undertaking that if an industry has to be nationalized in the interest of the country, just and equitable compensation would be paid to the dispossessed owners and their foreign partners. The compensation received by the foreign investor can be remitted freely to the country of his residence. Participation by foreign capital is permitted up to sixty per cent of the total investment in approved industries. The case of public utility concerns is considered on merit and the percentage of foreign capital that can be invested in them is decided separately in each case.

I believe it will be conceded that these concessions can be regarded as fair, or even generous, by any standards. The Government of Pakistan realizes that, although indigenous capital is not as shy as it was five years ago and the country does get considerable assistance from a number of friendly nations and organizations, the programme undertaken by the Government is so ambitious and of such vital importance to the country's economic well-being that all encouragement should be given to make it worthwhile for foreign investors to take active interest in our development projects. Pakistan has allied herself with the free world. Rapid industrialization can make her strong and an asset to the free world. With her tremendous resources in manpower, occupying the strategic position that she has between the Middle East and the Far East, a strong Pakistan could be a force for good in the cause of peace.

DISCUSSION

SIR HAROLD SHOOBERT, C.I.E., E.D.: His Excellency mentioned the development of sugar. Among the places he mentioned, did he include Mardan or is it known under another name now?

THE LECTURER: The factory at Mardan is already in existence. I mentioned the two other new ones. These are new projects and I did not mention the old ones which are already in production.

SIR HAROLD SHOOBERT: Thank you. I asked the question because the Mardan factory began after Independence was granted.

MISS E. P. QUIGLY: I have recently been reading Dr. Bilgrami's book, *Some Aspects of Education*, in which he advocates that education should now be pursued in

on Islamic principles. Would His Excellency be kind enough to say if it is going to be very expensive, from the economic point of view, to change over from the old type of education to education following the precepts of Islam?

THE LECTURER: I think the questioner knows more about the subject than I do, and probably if Dr. Bilgrami has examined this question we certainly would encourage the teaching of Islam in schools. But how can the whole of modern education be changed? For example, in English literature there is nothing Islamic. The point is that the bulk of the modern syllabus of education would have to be continued more or less in the same way. The idea is that as in the past no attention at all was paid to religious education, schools might introduce religious education so that the Muslims may know what their religion is. I do not see how one can make scientific or nuclear education Islamic or non-Islamic.

LIEUT.-COLONEL M. K. DURRAM, G.C.: What facilities do the Pakistan Government propose to give the Foreign Minister as an added stimulus to foreign investment?

THE LECTURER: I read out those four special incentives. If you are a Pakistani investor, you are not entitled to them. Those facilities were meant for the foreign investors.

MR. A. M. NIZAMI: Would it be true to say that the areas in Pakistan have made more progress in the last eight years than during the ninety years of British rule?

THE LECTURER: I do not think it would be quite correct, as Lord Hailey pointed out that when he went as Assistant Commissioner most of the entire area of Pakistan was a howling desert. It was only when the irrigation projects had been completed and people were in a position to settle down and have a decent standard of living that one could think of industrialization.

MR. NIZAMI: I meant industrial progress.

THE LECTURER: Yes, my point is that in each project different things have been done. We were beginning to convert the desert into fertile lands and on the fertile lands now the factories are coming. I should say that probably some more factories could have been established in the area which is now Pakistan but then we were thinking of the continent of India. I am not defending anything, but I worked in the Industries Department and the chief criteria were the advantages available in that particular area for certain industries. The whole of Gondwana, for instance, has got enormous resources, one of the world's largest resources of coal, iron ore, bauxite, copper and everything. Naturally the bulk of the investment went into that area compared with ours. We have a national necessity to develop industries because they are the basis of our living; but at that time Pakistan being a part of India, India as a whole was being developed and certain areas were left behind, I will not say neglected.

MR. SATISH BHATNAGAR: If there were two offers, say from American capital and Russian capital, would there be any distinction made?

THE LECTURER: I think that when we do get that investment we shall decide whether there should be any distinction. No Russian capital has been advanced to Pakistan and none would be. So far as the American capital is concerned the bulk of it is coming in the shape of aid. We draw up a scheme, we discuss it with them and in every case only the foreign expenditure is met by the foreign aid, the rest has to be met by us. All the work that has to be done on a factory, for example, on the buildings, roads, and so on, has to be done by us. It is only the machines which we lack that are provided by the foreign aid. In some cases as much as eighty per cent is our own money.

THE CHAIRMAN: In thanking His Excellency for the address he has given us and the courtesy he has shown in replying to the questions put to him, I should point out that an address dealing with an economic subject and involving the quotation of

a considerable volume of facts and statistics is never a light or easy task. I will only ask the audience to remember that behind all these questions of industrial advance, or the growth of factories, or irrigation, or hydro-electric development there are great human problems. These problems involve in the present case the welfare of some 80 million people, members of the Commonwealth, with whom we ourselves have had close relations in the past and whose future is a matter of great concern to us. The measures to which His Excellency has referred relate to the development, within a comparatively short space of time, of a rural into an industrial, or at all events a semi-industrial, community.

One might almost be inclined to ask whether the attempt which has been made to achieve this result has not been too hurried, and has imposed too great a strain on the energies of a government and a people which have only just taken command of their own destinies.

His Excellency has acknowledged the assistance, both technical and financial, which Pakistan has received from its friends in dealing with the task imposed on it. Everyone hopes that this assistance will be continued for it is greatly needed. Pakistan has approached its problems boldly and with courage. If it is to look for assistance in its task, it will need all the goodwill that its friends can give it. But on its part it must make the one contribution that can ensure the help of its friends—it must endeavour to present to them a picture of stability, of administrative efficiency and of popular contentment. Given these things, there will be no difficulty in securing the material aid of its friends.

A vote of thanks to the Lecturer was carried with acclamation.

THE LECTURER: I would like to say how sincerely grateful I am to Lord Hailey for his remarks. I shall certainly convey them to the people of Pakistan. Lord Hailey has probably forgotten how much respect and admiration the people of the Punjab have for him. I deliberately tried to keep my talk within bounds. I assure you the picture that I have given can be enlarged many times. If I were to dwell on the assistance, educational and technical, we are getting in all fields and particularly from this country (for instance at any given time there are 2,000 Pakistanis studying here) it will show what an amount of interest you are taking in our development programme and what great assistance you are rendering to us. Thank you very much.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C. (Chairman, Commonwealth Section Committee): I should like to extend a very sincere welcome first of all to Mrs. van Dulken who is, as you know, the daughter of the great benefactor responsible for establishing this lecture. Then, may I say how pleased we are to see with us once again Sir Harold Shoobert and many other members of the Pakistan Society and also many Pakistanis whom I should like to welcome here.

It falls to my privilege to move a very hearty vote of thanks to our chairman. I think it is common knowledge that Lord Hailey, after spending some forty years, from 1895 to 1934, in the Indian sub-continent, most of which time was spent in what is now Pakistan, undertook the monumental African Survey. I do not think, however, it is quite as well known that, at his present age of 84, he still gets up at 6 a.m. and works every day at Chatham House on the many amendments to that African Survey necessitated by the great constitutional changes which are taking place in Africa at the present time. I may say he goes on working until 7 p.m.! I wonder which one of us, if we are lucky enough to get to his age, would be able to put up such a wonderful record? I mention this because I am sure you will agree with me that we owe him a great debt of gratitude for coming here this afternoon and presiding over His Excellency Mr. Mohammed Ikramullah's most illuminating and comprehensive lecture. Now I am going to ask you to help me thank our chairman, Lord Hailey.

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

THE BRITISH GLASSHOUSE INDUSTRY

A paper by

W. F. BEWLEY, C.B.E., D.Sc., V.M.H.,

Director, Glasshouse Crops Research Institute, read to the Society on Wednesday, 22nd February, 1956, with Sir Edward Salisbury, C.B.E., D.Sc., F.R.S., V.M.H., Director, Royal Botanic Gardens, Kew, in the Chair

THE CHAIRMAN: It is my privilege and my pleasure to introduce to you our lecturer this afternoon, Dr. Bewley, who has been Director of the Glasshouse Research Station for I believe now 37 years. You will not believe that he was as old as thirty when he was appointed, we all think of him as much younger than he is. You will realize that when he talks to you, and I am sure we are going to have a very interesting paper.

The following paper was then read:

THE PAPER

In my book *Commercial Glasshouse Crops* which I wrote very largely during World War II, I wrote:

> The glasshouse industry which started about a hundred years ago, has reached an interesting stage in its development. Even now it is the most highly capitalized, the most productive and the most complicated of all the branches of horticulture, but given favourable economic conditions and the same desire to progress as that which imbued its pioneers, it could reach heights of efficiency in scientific crop production which few have ever visualized.

If I believed that in 1950—how much more must I do so now. In the six years that have elapsed, however, since my book was first published there have been serious economic changes and these have influenced the present position; it would be a brave man who ventured to prophesy about the immediate future.

HISTORY

The very beginning of the glasshouse industry depended, as its name implies, upon the discovery of glass which, 500 years ago, was a luxury. At one time, only the very rich could afford to have glass-filled windows in their houses. When they changed homes they took their windows with them and it was in their beautiful gardens that glass was first used to protect valuable plants or, in other words, the idea of a glasshouse was conceived.

At first simple frames were used to cover hot beds, where tender vegetables and cucumbers were grown. Later these frames were leaned up against walls to protect fruit trees from frost. At first these were merely large glazed wooden frames, with the top resting near the top of a wall while the base rested on the

ground four or five feet from the bottom of the wall. At first these were mobile, but gradually more elaborate fixed structures came into being and the earliest glasshouse, the 'lean-to', was born. Of various shapes and sizes, these consisted essentially of a brick wall, some nine feet high on the north side, with a sloping roof of glass from the top of the wall on the north side to a low wall built some seven or eight feet to the south. Glass ends, containing doors, were fitted to complete the job. These structures were used chiefly to protect vines, peaches and nectarines growing on the walls. They were dark in comparison with modern structures, for the glass panes were only five or six inches wide and the wooden bars were substantially thick. Also the roof apex was small because the gardeners feared that if snow lay on the glass it would cause damage.

Later, as gardeners found that snow did not damage their structures, they produced more adventurous designs and built lean-tos with wider bases. The next step was the creation of the three-quarter span, which enabled a longer run of vine to be grown without increasing the height of the wall.

Later still, the modern span greenhouse or glasshouse was invented. At first these were separate structures, with a double roof sloping from a relatively high ridge to two gutters, one on either side. From gutter to ground level, or to the top of a low wall, were glass sides. Glass ends, doors and ventilators completed the house. These units were orientated with the long axis north to south. Later it became the practice to unite several houses in one block, thus achieving cheaper construction by omitting most of the side walls.

Ultimately we arrive at a time, about the middle of the last century, when probably in several parts of the country there arose the idea of commercializing the cultivation of plants in glasshouses. This was probably in the 'forties, for we know that by that time skilled gardeners along the south coast, in the north and west of London, and in the Island of Guernsey, had already learned the art of cultivating plants in the somewhat primitive glasshouses in their masters' gardens. In Worthing the pioneer was a Mr. Head who, in the early 'forties of the last century, built in Anchor Lane two houses each a hundred feet in length They were glazed with small square pieces of glass and were planted with Pope's strawberry vines, the fruit from which was sold in Brighton market. The nursery was gradually extended and ultimately passed to Mr. Thomas Bushby, who was the pioneer grower of tomatoes in Worthing.

In Guernsey grapes were grown in glasshouses about the same time. We are told that many varieties were used, including Black Hamburg, Sweet Water, Muscat of Alexandria and White Syrian. The last of these is said to have produced bunches two feet in length and one and a half feet across the shoulders when it was first introduced. It sounds like an exceptional F1 hybrid. At first all attempts to sell the fruit failed both locally and in Covent Garden. So bad was the trade that the glasshouses were allowed to deteriorate without any attempt being made to repair them. Later, however, the venture was attempted again and in 1856 four tons of grapes were sold in Covent Garden.

Wheadon, in his excellent little book *The History and Cultivation of the Tomato in Guernsey*, la Société Guernesiase, Guernsey, says that one of the first occasions

on which tomatoes were grown under glass in Guernsey for the market was in 1874 by Mr. J. Hodges working for Mr. Nightingale at Mon Plaisir.

Lea Valley area

Commercial glasshouse work in North and West London started in florists' shops like those of Messrs. Bull, Cutbush, Weekes and Veitch, who had show-houses and supplied gentlemen's gardens with plants, seeds and sundries. There is a nice little story also about a bookbinder, Charles Wood by name, who sometime between 1840 and 1850 noticed the drabness of his shop and attempted to brighten it with flowers from his garden, which he displayed in his window. So many people attracted by the flowers asked to buy them that he saw the possibilities of a florist's shop and gradually developed into a grower and incidentally a seller of flowers.

Other gardeners, destined to play an important part in the Lea Valley area, built nurseries at Finchley, Edmonton and Tottenham. They include such names as C. H. Shoults, John Kay, James Sweet, H. B. May, and George Beckwith. At Page Green, a Yorkshireman, Mr. J. Rochford, built a considerable area of glasshouses for cultivating bedding stuff and plants in pots. About 1880 the nurserymen in North London seemed to become restless, because shortly afterwards we find them seeking new homes in the valley of Lea.

In 1882 Mr. Joseph Rochford, whose family were later to become famous in the glasshouse industry, started to build a nursery at Marsh Lane, Turnford, and his brother Thomas followed soon after. About the same time Robert Hamilton built Providence Nursery at Waltham Cross. Later, in 1887, Mr. Joseph Rochford built his famous Jubilee House extending over a quarter of an acre of land, and grew first tomatoes and then grapes. It is probable that this was the first crop of tomatoes in the Lea Valley.

After the year 1890 growers began to settle in Cheshunt and nurseries began to go up all around the district. In the Flamstead End area the name of Stevens soon became famous for high-class roses, and remains so to-day. To Cheshunt went C. H. Shoults, to Waltham Cross went H. O. Larsen, J. Nielsen, W. B. Randall and R. Cobley. To Hoddesdon went R. L. Glasspool, J. Harnett and W. Dyke. Important improvements in glasshouse heating arose in the Lea Valley. Mr. Joseph Rochford designed the Rochford type of tubular boiler and also initiated the standard method of building glasshouses in blocks instead of single as before. The rate at which the industry grew was a little astounding and, although it is not easy to get authentic figures for the whole industry, those provided by the late Mr. C. W. Cook, rating and valuation officer of Cheshunt, are interesting.

Area of glass in the parish of Cheshunt

Year	*Acres covered*
1900	264
1910	345
1914	429
1920	435
1929	667

To-day the Lea Valley area in Middlesex, Essex and Hertfordshire probably covers some 1,400 acres.

Other areas

While the above-named areas are the most important in England, there are others in the Thames Valley, North-West Kent, Blackpool, Hampshire, Norfolk, Staffordshire and Lancashire.

Scotland

In Scotland most of the glasshouse industry is devoted mainly to tomatoes, although bulbs and some flowers like the chrysanthemum are grown. It is located chiefly in the Clyde Valley with more recent developments around Edinburgh. The most famous parishes are Carluke, Lanark and Lesmahagow, which are all on the fringe of the great industrial area of Lanarkshire within 25 miles of Glasgow.

Wales

In Wales glasshouse nurseries are found in the north and also the south but there is no sign of any large areas developing.

Northern Ireland

In Northern Ireland glasshouse cultivation is of relatively recent introduction with the exception of a few nurseries built between the wars.

Future tendencies

The general trend of development is away from industrial areas towards the sunnier parts of the country. This is inevitable, because costs of production are rising so fast that the heaviest and most valuable crops will soon be the only ones that will pay.

THE DEVELOPMENT OF THE GLASSHOUSE INDUSTRY

(*a*) *Before World War I*

Because the glasshouse industry started with the cultivation of grapes, pot plants and bedding plants, the original houses were designed to suit these crops. Many of them were low, narrow structures with strong roof bars and rafters placed fairly close together and glazed with small panes of glass. As glass became stronger and growers had more experience of what it would stand, they used thinner bars and panes of glass up to 18 inches by 20 inches. Also houses became wider and were constructed in larger blocks. In the Lea Valley the so-called 'aeroplane' house came into being. The previous vinery type houses had been 28 to 30 feet wide, with gutters averaging 5 feet 6 inches and the ridge 12 feet 9 inches high. The new 'aeroplane' type had a width of 14 to 15 feet, with gutters 6 to 7 feet high, the ridge remaining 12 feet 9 inches. The high gutters allowed the back row of tomatoes more room than they had in the earlier houses and so increased the crop. As the industry progressed, pot plants and bedding stuff gave place to tomatoes, cucumbers, roses and carnations. Grapes, peaches and

nectarines were still grown by specialists, while chrysanthemums and mushrooms were grown in autumn and winter. Some pot plants and bulbs for forcing were also grown.

Although a proportion of the glasshouses in this country are not heated artificially, they form a section of their own and when referring to the glasshouse industry most of us think in terms of heated houses. The earliest houses were heated by means of a hot brick flue which passed along the centre of the house from one end where the boiler was situated, to the other at which the chimney was placed. These flues gave off a good deal of heat, but they often leaked and gases entered the house with results detrimental to the crops.

Central flues soon gave place to hot-water pipes in which hot water circulated by what was known as the 'gravity system', the power being the difference in weight of two columns of water—one being hot, the other cooler. Through the period before World War I the design of the boiler and the arrangement of the pipes were continually improving, but heating was still of an elementary type.

This first period of building up the industry, therefore, was one of individual development by pioneer growers who, having encountered and overcome many difficulties, had created for themselves successful businesses and showed little desire to co-operate with one another. This state of affairs could not last for ever, and indeed events occurred presently which compelled some growers at least to co-operate with their neighbours.

(*b*) *Between the two wars*

Development during this period was rapid; the building of nurseries went on without ceasing. The tomato went on from strength to strength, but the cultivation of the cucumber gradually decreased, both in the Lea Valley and the Worthing areas, very largely owing to several years of low prices. There was an increase in the acreage of roses and carnations, especially the latter. The cultivation of mushrooms as an autumn and winter crop in glasshouses increased considerably and the American type of mushroom house attracted more and more attention. Crops like grapes, peaches, nectarines and figs were grown less and less except along the south coast. The raising of Cheshunt Early Giant and Cheshunt 5B lettuces at the Cheshunt Research Station increased the cultivation of winter lettuce very considerably, and indeed started what was practically a new crop in glasshouses.

This period saw improvements in house construction in providing lighter and more airy houses. One or two growers on the south coast tried 24 inch by 24 inch glass with good results.

Messrs. Glasspool and Harnett were the first to circulate the hot water in their heating systems artificially. They injected steam from their steam sterilizing boiler into their hot-water pipes, thus raising the temperature of the water and circulating it rapidly during cold weather. This principle was later embodied in what came to be known as the steam-*cum*-water system, in which water in the heating pipes was heated solely, and also circulated, by means of special

injectors which introduced into them steam produced in large steam boilers. For a time this method was very popular, but even when it became less so it left in the minds of growers the lesson that the heating of their houses could be improved by circulating the water in the heating pipes. One result was the extended use of electric pump circulation. Up to this time a four-inch pipe was the standard type used for heating, but growers were beginning to examine the possibility of using a greater number of smaller pipes with the object of securing more uniform temperatures. The late Carl Englemann, carnation grower of Saffron Walden, installed a heating system using live steam in narrow pipes. In his large airy houses the system was highly successful.

A few years before the outbreak of World War I, growers were becoming more kindly disposed towards the suggestion of co-operation, with the result that growers' associations were formed in the Lea Valley (1911), Worthing (1912), North-West Kent, and so on. These were all quite separate organizations but they declared one object—co-operation between growers for the ultimate good of the industry. The outbreak of war in 1914 strengthened these bodies and at once proved their value because they provided means whereby growers could consult together in the national emergency.

After the war, difficulties in obtaining nursery supplies caused the Lea Valley Growers Association to form another company known as Nursery Trades Ltd., in 1920. About the same time they started a grading and packing scheme for tomatoes and cucumbers which became the basis of that sponsored by the National Mark. Then in 1922 the Lea Valley Growers were largely responsible for the formation of the British Glasshouse Produce Marketing Association, designed to advertise home-grown glasshouse produce. The services of advertising specialists were engaged at considerable cost covered by a levy on every package marketed by the members. The scheme was voluntary and, while it was supported by a great many growers, others refused to participate and although it survived for 15 years it was ultimately wound up. It was worthy of a better fate. The urge for national unity was about, however, and by 1927 most of the growers' associations (of which by this time there were many all over the country) had joined voluntarily with the National Farmers' Union. In 1932 the Worthing growers formed the Worthing and District Growers Ltd., to improve the transportation of produce from West Sussex to markets all over the country. In 1940 the Lea Valley Growers Transport Ltd., was formed for similar purposes.

In 1913 the Lea Valley Growers embarked upon a new type of adventure, by setting up the Experimental and Research Station at Cheshunt. It was indeed the first attempt of its kind in the country, because it was created by the growers themselves, who had learned to appreciate the benefits of scientific research, to employ scientific methods to solve certain problems affecting their industry: chief of these were the tomato moth caterpillar and 'soil sickness'. In this they had the support of the Ministry of Agriculture who added another £1 to every £1 subscribed by the growers.

When, after service with the Gunners, I joined the staff of this station in 1919 conditions were anything but encouraging. Funds were so low that the improviza-

tions we had to make would earn the scorn of any modern graduate. Refusal to accept defeat won in the end, but only when it was realized that if the scientists working at Cheshunt were capable of providing practical solutions to the growers' problems, they would in time gain their confidence and so build up a research organization worthy of the industry. The policy laid down was to direct research in such a manner that the results could be applied in a practical way to large-scale commercial work. This policy proved to be the right one, for the station ultimately earned a popularity that spread to every part of the British Isles and also overseas. In 1921, at the request of the Ministry of Agriculture, it became the National Station for all crops grown under glass.

Looking back to the end of World War I, it is easy to see the influence of scientific research upon the progress of the industry. Tomato crops are heavier and cleaner, and methods for producing better quality fruit have been devised. Improved varieties and those resistant to leaf mould are available. Winter lettuce in glasshouses has become an important crop through the raising of Cheshunt Early Giant and Cheshunt 5B at the Cheshunt Station.

The evil effects of virus diseases have been reduced by the use of virus-free tomato and cucumber seeds. It should not be forgotten that it was the growers themselves who started the Market Growers Seed Association Ltd. in 1939, for the purpose of growing and distributing virus-free seeds. A small modern nursery in Sussex now sells seeds from virus-free plants to its shareholders who have proved, beyond doubt, the benefits that accrue.

(c) *During World War II*

The glasshouse industry played a part in feeding the nation during the war in a way of which every member can be justly proud. Despite the glorious work of the Navy and Merchant Navy this country was likely to be short of such health-giving foods as oranges, lemons and grapefruit—the tomato was the one fruit to take their place. As soon as the war started, 'cropping orders' were imposed instructing growers to devote every possible square foot to the cultivation of tomatoes. Those who held valuable stocks of other crops including flowers were compelled to reduce the scale of production to ten per cent of what it was before the war. This dispensation was made in order that valuable stocks should be preserved for the time when peace returned. Growers accepted these changes with good grace, and it is to their undying credit that despite shortage of labour and all kinds of difficulties they so increased the total output of tomatoes that with the aid of an outdoor crop the total fruit in 1942 made up the deficiencies occasioned by the loss of the Netherlands and the Channel Islands.

(d) *Since World War II*

What is the state of the industry to-day? Thanks to the kindness of H. W. Durrant, of the Horticultural Price Statistics Branch of the Ministry, I am able to quote certain figures from the 4th July returns for 1955. These given below show very clearly the total areas of crops in January and July, 1954, and 1955:

(*a*) ACREAGE OF CROPS IN GLASSHOUSES

Crops	*July* 1954	*July* 1955
Tomatoes (heated)	3092	2431
Tomatoes (unheated)		569
Cucumbers	480	455
Lettuce	—	—
French beans	—	—
Mushrooms	—	—
Other vegetables and herbs	33	28
Grapes	32	26
Peaches and nectarines	18	17
Other fruits	5	4
Carnations	182	191
Roses	106	115
Orchids	10	10
All other flowers and foliage crops	344	366

(*b*) PRECEDING JANUARY RETURNS

Crops	1954	1955
Lettuce	520	505
French beans	3	3
Mushrooms	38	32
Other vegetables and herbs	62	65
All other flowers and foliage crops	592	647

On 4th July, 1955, glasshouses on nurseries possessing more than 1,000 feet of glass totalled 3,851 acres of heated glass and 763 acres of unheated glass.

The tomato is always the most widely grown crop, with cucumbers second and unclassified flowers third, carnations and roses coming fourth and fifth respectively.

In winter, as shown by the 15th January returns, there were some 505 acres of lettuce and again a large quantity of unclassified flowers and foliage.

Growers of glasshouse crops are in a peculiar position to-day. They face production costs many times greater than in 1939 and, although the value of their produce has also increased it is not sufficient to meet rising costs. Indeed, the glasshouse industry is probably the only one where costs of production are rising while the value of its products are falling.

Statistics published by the Tomato and Cucumber Marketing Board in their *Journal* for December, 1955, provide ample confirmation of this fact, as their table reproduced below will show. The rise in wholesale prices for tomatoes during the past four years has been much less than increases in the average price of all articles and goods sold. During 1955 the wholesale price for tomatoes was three times the pre-war figure, but the chief items in the growers' costs—coal and wages—are nearly five times and four times this figure respectively.

PRICE AND WAGE INDICES

Year	*Average wholesale price for English tomatoes (May-November)*	*Wholesale price of all articles and goods*	*Price of coal*	*Agricultural workers. Minimum rates of wages based on hours worked*
1930/8	100	100	100	100
1940 ...	203	n.k.	140	142
1945 ...	157	n.k.	237	219
1950 ...	232	n.k.	304	311
1951 ...	285	n.k.	340	338
1952 ...	274	323	380	357
1953 ...	265	324	406	376
1954 ...	301	325	423	394
1955*...	294	330	433 (1st half) 492 (2nd half)	394

* All 1955 figures are provisional. n.k.—not known.

Unless this lack of balance can be adjusted the future for many is black.

Can we take hope from what has happened in the past?

(*a*) The industry has throughout its history continually faced innumerable difficulties—all of which it has overcome. The organized brains of the industry with the Ministry of Agriculture and Fisheries, and the Government, can work out its salvation again.

(*b*) Scientific research has, in the past, controlled pests like the tomato moth caterpillar; white fly; red spider mite; thrips; wireworms, and so on; diseases like damping off and foot rot; Verticillium wilt; Didymella stem rot; Botrytis stem rot; leaf mould of tomato, and so on. It has also solved problems such as soil sickness; mineral deficiency disorders; fruit discolouration disorders, and soil sterilization. It can be relied upon to do what is necessary, provided it keeps the practical application ever before it.

Now the industry is better provided with scientific assistance than ever before. It has its own new 'Glasshouse Crops Research Institute' at Littlehampton for fundamental research, which has now taken the place of the Cheshunt Research Station closed down in 1955; several experimental stations of the

National Agricultural Advisory Service, and a number of specialist research institutes and university departments interested in its problems.

In February, 1951, the Tomato and Cucumber Marketing Board came into being. It is essentially an organization administered by the growers themselves for the benefit of the whole industry. It has the thankless task of trying to please everyone and it would be surprising if it succeeded in doing so. Its attempts to maintain prices, and improve quality, grading and marketing have already indicated what it could do if every grower gave it wholehearted support.

DISCUSSION

MR. A. A. POLLARD: Can the lecturer tell us whether any work is being done on virus diseases at the present time?

THE LECTURER: We started virus work many years ago and I think that we did good work when we showed that virus diseases of the tomato are transmitted in the seed. We also confirmed what other people had found before, that virus diseases of the tomato are transmitted from smoking tobacco. We think that the grower has in his own hands the control of virus diseases of the tomato.

So far as the cucumber is concerned, the virus diseases of the cucumber which were common years ago are very seldom seen to-day, because virus diseases of the cucumber are also carried in cucumber seed. Now we insist upon seeds taken from clean plants, so there is little cucumber virus to-day. This virus is not readily carried from other plants to commercial cucumber crops.

There are certain virus diseases that are very, very serious, however. One of them is the flower distortion virus of the chrysanthemum. We first met that one just before the war and after the war I issued a warning in very definite terms, pointing out how serious this virus disease of the chrysanthemum would become if steps were not taken to control it. Very few people took any notice of it, and the result is that we still have chrysanthemum virus in the country. Mr. Pollard is a grower of carnations, however, and possibly it is this plant which interests him.

Now virus diseases in the carnation are very serious and I believe Dr. Kassanis, a member of the staff of Rothamsted Experimental Station, has voiced the opinion that there is not a single carnation plant in this country that is free from virus. If that is true, and there is no reason for doubt, then either virus diseases of the carnation just do not matter or else we must do something about them. So far as mild carnation virus in the country is concerned growers have learnt how to cultivate carnations so well that apparently they thrive although they are infected with this virus. Personally, I consider this is a dangerous situation and I hope someone will try to establish a centre at which virus-free carnations and virus-free chrysanthemums can be grown and distributed. I think this is a job for a scientist and not a grower, or perhaps the two combined. So there is chance for the new generation of scientists to do something about this most important problem.

The work of our virologist, Dr. Howles, which incidentally I started myself at Cheshunt, is being continued steadily at Littlehampton. Recently he has been examining the effect of certain growth-promoting substances on many different viruses.

MR. S. L. LORD: Could Dr. Bewley give us any tips about wilt in carnations?

THE LECTURER: There are several wilt diseases of the carnation. The original fungus wilts of carnation were caused either by Fusarium or else Verticillium. Good measures of controlling these have been worked out. We have proved on many nurseries that it is possible to achieve freedom from these by the simple process of maintaining special houses in which stock plants are grown in pots, for the

special purpose of providing cuttings for propagating new plants. By this means any diseased plant can be destroyed before the disease spreads to neighbouring plants, as would certainly happen if the stock plants were being grown directly in the ground. The lesson from all our experience with these diseases is therefore to maintain stock plants in pots.

There are, of course, two new wilt diseases of the carnation of which we have little experience in this country. They are bacterial wilt diseases. Our knowledge of the first of these diseases comes from Denmark and we have not found very much of it in this country. It is caused by *Pseudomona Caryophylli*. The second of these bacterial diseases was discovered recently in this country. It seems to be more dangerous than the first, and growers would be well advised to report any cases of wilt they may encounter to the Advisory Officer of their county. Uncontrolled distribution could be a serious matter.

MR. S. G. NORRINGTON: Could the lecturer tell us the weight and quality of the glass used?

THE LECTURER: We use mainly twenty-ounce horticultural glass supplied by one of the well-known manufacturers. At Cheshunt we tested one of the ultra-violet transmitting types of glass many years ago. The makers gave me sufficient glass with which to glaze half a cucumber house. We grew cucumbers under standard conditions in that house for a number of years. There was an appreciable increase in crop under the special glass at first. After about six years, however, the glass seemed to have lost its power to transmit the short rays, because the difference in yield under the different types of glass was not maintained.

Normally the size of our glass sheets is 18 inches by 20 inches, but recently there has been a tendency to use larger sheets. When building our new houses at Littlehampton we have used sheets 24 inches by 24 inches with excellent results and apparently no increase in the percentage of breakage during the winter.

MR. D. NEVILLE-JONES: Does the lecturer think any practical interest attaches to the efforts that have been made in Germany to increase production of glasshouses by putting up the concentration of carbon dioxide (CO_2)?

THE LECTURER: Some years ago we investigated this problem at Cheshunt. We came to the conclusion that, although crop increases up to thirty per cent could be induced by raising the concentration of carbon dioxide in the air of glasshouses, we could not secure full advantage of the process because the intensity of our light was too low. It is possible that better results could be obtained in the Channel Islands where light conditions are so much better. Furthermore, the methods for generating the gas did not prove economic.

THE CHAIRMAN: I am sure you would not like to disperse without expressing to Dr. Bewley our deep indebtedness to him for the most interesting account he has given us of the development of the glasshouse industry.

I could not help thinking, when I heard him describe those early phases, how history repeats itself. He referred to the way in which glasshouses began by somebody propping up a pane of glass over a plant. The same thing has happened in alpine gardening, in the rock garden; it started with a pane of glass and now it has got to the little miniature greenhouse, the *cloche*. But if one peruses the early reports of the successive years of the Cheshunt Research Station one of the things that impresses one is that most of the papers put out during the first decade were produced by Dr. Bewley himself, dealing mostly with diseases of the tomato. Even if he was not able, because of his other duties, to be quite so prolific in later years, one realizes from the numerous papers that came out how actively research was pursued in that institution.

I would like to stress the complexity of the problems which face the investigation of any growing industry of that sort. Whether in the field of horticulture or the field

of agriculture one is dealing with a whole complex of phenomena, in fact, as an ecologist I like to think of agriculture and horticulture as applied ecology and I do not think anybody would take exception to that. The point of the ecological approach is not that it is a new subject, although it is a new name, but that it represents an integration of the contributions from many subjects. That I think is the aspect one has to bear in mind in connection with an industry such as the glasshouse industry—the way in which the contributions from a number of specialities are brought to bear on the problem. For example, Dr. Bewley has referred to that excellent work which was done at Rothamsted on soil sterilization. Now in fairness, in that connection, one ought to refer to the name of Dr. Hutchinson because I think Sir John Russell would be the first to admit that Hutchinson's share in that work on soil sterilization was as great as, and perhaps even greater than, his own. Also one should refer to the name of Dr. Cutler. Dr. Cutler was the protozoologist on the staff of Rothamsted at that time and Dr. Hutchinson was the bacteriologist. There the combined expert knowledge of a protozoologist, a bacteriologist and a soil chemist were concentrated on that one problem. So too in the pursuit of these problems at Cheshunt we have the combination of the work of plant pathologists, entomologists, soil physicists and so forth. That represents at once the difficulty of solving these problems and the interest of their solution.

One of the great problems that faces us to-day is the deployment of our relatively limited scientific manpower to the best advantage. Consequently, with the numerous problems that open up as our knowledge advances, we have to consider this important point—not merely what practical difficulties are to be solved by attacking any particular problem, but how far the attack on that problem will also add to fundamental knowledge, so that the answer to the problems of to-day may help us to answer the problems of to-morrow.

During his years at Cheshunt, Dr. Bewley has become the guide, comforter and friend of the glasshouse industry. It is a salutary maxim that people who live in glass houses should not throw stones, but Dr. Bewley has never hesitated to throw stones at outworn shibboliths or at outmoded practice and perhaps more than anything else Cheshunt is an example of combination both of theory and practice.

Cheshunt has gone and its place is taken by Littlehampton and very soon Dr. Bewley will be retiring, but if the glasshouse research has moved into a second phase that has only been possible by the pioneer work which Dr. Bewley carried out. His services to the State were recognized by his creation as a C.B.E. His services were recognized in the horticultural field by the Royal Horticultural Society, by the award of the Victoria Medal of Honour, the highest award which the Royal Horticultural Society has in its power to offer. But you I am sure would wish here to express not only your appreciation for the interesting paper that he has read, but also at the same time your appreciation of the services which he has rendered to the glasshouse industry.

A vote of thanks to the Lecturer was carried with acclamation.

SIR JOHN SIMONSEN (A Member of Council of the Society): I am sure after this most excellent paper you would wish to express your appreciation of the kindness of Sir Edward Salisbury in presiding to-day. In more congenial circumstances, external circumstances I mean, all of you have visited Kew and enjoyed the beauties of those gardens, but I wonder how many fully realize that it is the greatest source of botanical research not only in this country, but probably in the world. It is indeed fortunate that we have had for so many years Sir Edward directing its activities. We are therefore especially grateful to him for coming here to preside over this meeting, since after all he also lives with glasshouses as does the glasshouse industry.

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

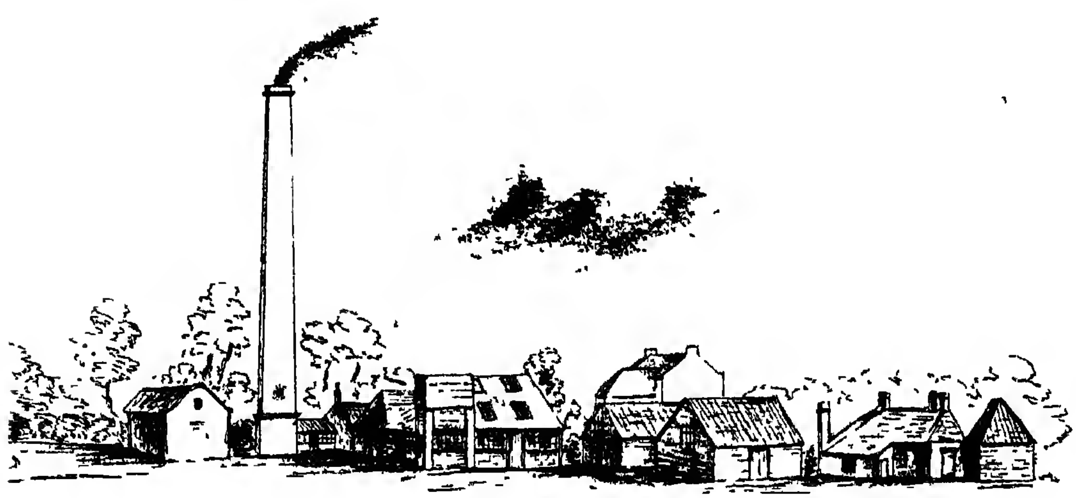
GENERAL NOTES

THE PERKIN CENTENARY

In the Easter vacation of 1856 an eighteen year-old student of the Royal College of Chemistry, William Henry Perkin, working at home, attempted to synthesize quinine, using the coal-tar derivative aniline as a base. The result was a black powder which, when dissolved in alcohol, produced a brilliant mauve liquid. Further experiment showed Perkin that this aniline product was in fact a dye, later to be named mauveine. Realizing the significance of this, Perkin in August took out a patent for the discovery; by October he had already determined to manufacture the dye and, a lad of 18, had persuaded his father to put all his savings into the invention. By the end of the following year his own factory was built and in operation, and this at a time when organic chemistry was in its infancy. The significance of these achievements, which are being widely celebrated this month, is best summed up in the citation for the award to Perkin of the Albert Medal of the Society of Arts 34 years later: 'for his discovery of the method of obtaining colouring matter from coal-tar, a discovery which led to the establishment of a new and important industry, and to the utilization of large quantities of a previously worthless material'.

Perkin had, in fact, set in train the marriage of chemistry with industry in setting up a factory for the commercial exploitation of his process. It was the first factory in the world for the industrial manufacture of an organic chemical. Not only this, it began the emancipation of the British textile industry from that reliance upon the natural dyestuffs which was seriously hindering its further development.

The Society had always been deeply concerned to improve the country's supply of the natural dyestuffs, and Perkin's discovery was therefore of considerable interest to it. In 1868 he delivered a course of Cantor Lectures to the Society, on 'The aniline or coal-tar colours'. In the following year he made a further advance in this field by producing, simultaneously with two German scientists, artificial alizarin, the base of the red dyes. This had previously been obtainable only from madder, for the cultivation of which in this country the Society had offered premiums almost annually from 1754 to 1775. In 1879 Perkin again addressed the Society, delivering two lectures on 'The history of alizarin and allied colouring matters and their production from coal-tar'. In 1890 as already mentioned, he was awarded the Albert Medal, which was presented to him in the following year by the Prince of Wales, then President of the Society.



The Coal-tar Colour Works, Greenfor Green, in 1858.
Reproduced from the Journal for 30th May, 1879

The celebrations this month, under the patronage of His Royal Highness The Duke of Edinburgh, and sponsored by the Royal Society and a group of five specialist Societies, have taken the form of a Conference and social functions, supplemented by an excellent exhibition at the Science Museum. On the evening of 7th May, the principal overseas guests were entertained at the Tallow Chandlers' Hall by representatives of the Councils of the sponsoring bodies. On Tuesday, 8th May, the opening paper of the Conference, on the 'Life and work of Perkin' was read by Professor John Reed, and in the evening a reception for all conference members, and guests, was held at the Guildhall. On 9th May papers on 'The rise of the British Dyestuffs Industry', and 'The application of the British Dyestuffs Industry', were read by Clifford Paine and J. L. Evans, respectively and the final paper, on 'The development of Organic Chemistry since Perkin's discovery', was read by Sir Alexander Todd on Thursday, 10th May, followed in the evening by a banquet at the Dorchester Hotel.

The Perkin Exhibition at the Science Museum, at present intended to remain open until 8th June, starts with a series of *tableaux* depicting the use of dyes from ancient Egypt to the present, and proceeds to demonstrate chronologically the discovery and development of the chemical dyestuffs industry. Several of Perkin's notebooks are shown, together with samples of fabrics dyed by him in the early days. There are also cases containing models of dyestuffs works, and others showing materials dyed with the latest colours, loaned by firms who are members of the British Colour Council. The continuous research and experiment which have taken place in order that Perkin's first discovery might lead to the modern range of fast chemical dyes, and to a British Standard of Colour, are amply demonstrated.

The Exhibition is open from 10 a.m. to 6 p.m. on week days and from 2.30 p.m. to 6 p.m. on Sundays. Admission is free.

GRENADIER GUARDS EXHIBITION

The history of the Grenadier Guards in the 300 years which have elapsed since the Regiment was founded by Charles II, then in exile in Bruges, is to be illustrated by a tercentenary Exhibition which is to be held, by gracious permission of Her Majesty The Queen, at St. James's Palace from 30th May to 23rd June. Among the exhibits will be a number loaned by Her Majesty The Queen from the Royal Collection.

The Exhibition will be open from 11 a.m. to 7 p.m. on weekdays, and from 2 p.m. to 7 p.m. on Sundays.

DESIGN IN COTTON EXHIBITION

The first in a series of special displays at the Design Centre opens to the public at 3 p.m. on Monday, 4th June. The Exhibition will be devoted mainly to cotton dress and furnishing fabrics, both woven and printed. This display is additional to the permanent but changing exhibition of durable consumer goods.

The Design Centre, 28 Haymarket, London, S.W.1, is open to the public on weekdays, including Saturdays, from 9.30 a.m. to 5.30 p.m. Admission is free.

CITY AND GUILDS BROADSHEET

The City and Guilds of London Institute has instituted a Broadsheet, the first two numbers of which have already appeared, and which it is intended to issue in February, April, June, October and December of each year. The Broadsheet is to report on a selection of the Institute's activities, which are concerned with the promotion of technical and technological education. The wide scale of the Institute's work as the partner of industry in this field is demonstrated by the fact that there are annually over 100,000 candidates for its examinations in the whole field of technology.

SANDERSON BURSARIES

An exhibition of flower studies by students who have been awarded a Harold W. Sanderson Art in Industry bursary is at present on view at the Imperial Institute, where it will remain until 3rd June. The Exhibition is open on Mondays to Fridays from 10 a.m. to 4.30 p.m.; on Saturdays from 10 a.m. to 5 p.m.; and from 2.30 to 6 p.m. on Sundays.

The Bursaries are open to students aged from 15 to 23, and those who are successful receive a five-year training, working in a studio at the Perivale works of Messrs. Sanderson and making conducted visits to art galleries, and abroad. Full particulars of the scheme are obtainable from the Secretary, The Harold W. Sanderson Art in Industry Fund, Messrs. A. Sanderson & Sons, Perivale, Greenford, Middlesex.

OBITUARY

SIR DAVID RUSSELL

We record with regret the death, at Leven, Fife, on 12th May, of Sir David Russell, a former Assessor to the Chancellor of St. Andrews University.

David Russell, LL.D., F.R.S.E., F.S.A., F.L.S., F.S.A.(Scot.), J.P., was born in 1872, and educated at Clifton Bank, St. Andrews, and at the University of Edinburgh. He then entered the papermaking firm of Tullis, Russell & Co. Ltd., of which he became managing director. For many years he was associated with St. Andrews University, of which he was a Doctor of Laws. He was from 1938 to 1955 the Chancellor's Assessor on the University Court.

Sir David was a member of several learned Societies, and was also a trustee of the Walker Trust and vice-president of the National Trust for Scotland. In 1920 he edited jointly with the Very Rev. Professor W. P. Paterson *The Power of Prayer*, and in 1947 edited a work on *The Great Palace of the Byzantine Emperors*. He was knighted in 1946.

He was elected a Life Fellow of the Society in 1923.

DR. S. WHITEHEAD

We record with regret the death, on 5th May, 1956, of Dr. Stanley Whitehead.

Stanley Whitehead, M.A., D.Sc., M.I.E.E., F.Inst.P., was born in 1902, and educated at Jesus College, Oxford and Queen Mary College, London, of which he was later elected an Honorary Fellow. He joined the British Electrical and Allied Industries Research Association in 1925 as a technical assistant; during the last war he played a leading part in the E.R.A.'s work on bomb and mine locators, and in 1946 was appointed Director of the Association. He was a Manager of the Royal Institution and among his many other positions were the Honorary Treasurership of the Institute of Physics and an Honorary Secretaryship of the Parliamentary and Scientific Committee; he was a member of the Board of Studies in Electrical Engineering, London University, a member and past Chairman of the International Special Committee on Radio Interference, and Chairman of the I.E.C. Sub-Committee on High Voltage Measurement. He had written works on the *Dielectric Breakdown of Solids* and on *Dielectric Phenomena*, and had delivered many papers for scientific and technical bodies.

Dr. Whitehead was elected a Fellow of the Society in 1947.

NOTES ON BOOKS

BRISTOL CREAM. *By Godfrey Harrison. London, Batsford*, 1956. 18*s*

The centuries of unbroken prosperity which Bristol has been privileged to enjoy rested originally upon the export of wool and the import of wine: wool has long since ceased to be exported from any English port, but Bristol still imports and

re-exports wine as of old. Bristol is described in *Gesta Stephani* as 'the most opulent city in all these parts, as its shipping brings merchandise to and from the neighbouring coasts and from foreign parts'. That was in Norman times. Then came the Plantagenets and the close association of Bordeaux and Bristol, which is still very much alive to-day. But greater wealth through wine was to come to Bristol at the time of the Restoration, when it was enacted by 15 Car. II, cap. 7 (1665), that 'no commoditie of the growth or manufacture of Europe shall be imported into any of the Plantations unless shipped in England and in English-built shipping legally manned, and carried directly thither on pain of forfeiture'. The 'Plantations', at the time, were the West Indies and Leeward Islands, and the settlements on the mainland, New England, New York, Maryland, Carolina and Virginia.

During the whole of the seventeenth century Sack, mostly Sherris-Sack from Jerez, but also Canary Sack, was the most popular wine in England. It was imported in much greater quantities than other wines from France, Portugal or Germany; there is every reason to believe that it was practically the only wine to be re-exported from Bristol to the West Indies and America. During the eighteenth century, however, the wines of Spain lost their lead to the wines of Lisbon and Oporto, more particularly in London, Suffolk, Norfolk and Yorkshire, whilst the West of England retained much longer its predilection for the wines of Jerez.

Why the Sherry which was shipped from Bristol to the Caribbean Isles and the American mainland came to be known as 'Bristol Milk' is one of the questions which Mr. Harrison deals with, and he also gives us the official version of how *Bristol Milk*, a name which every Bristol wine-merchant has an equal right to use, became *Bristol Cream*, one of Messrs. John Harvey & Sons' registered trade marks. Mr. Harrison has done more and better than giving us an account of the rise to fame of one of the oldest Bristol firms of wine-merchants: it is, of course, his main theme and a very fascinating one as Mr. Harrison presents it to us, fascinating because he has fitted his story to the historical background of a port which has been for so long the home of bold and adventurous mariners, and of a city second to London, and London only, in its intimate connection with the wine trade, a branch of commerce long and rightly regarded as an honourable and highly respected profession. But, granting as we must, that the story which Mr. Harrison had to tell was a very interesting one, it is the manner of the telling which makes it both entertaining and convincing.

The book is a Batsford book, that is fully illustrated and charmingly produced.

ANDRÉ L. SIMON

MUGHAL MINIATURES. *By Rai Krishnadasa. India, Lalit Kala Akademi*, 1955

This is the first of a series of illustrated brochures on Indian art planned by the Lalit Kala Akademi, which has succeeded the former Bharat Kala Samiti. The general editor is Karl Khandalavala. Special attention is to be paid to the quality of the reproductions, which in this publication are certainly excellent. They are ten in number, all in colour. Each is accompanied by a note by Rai Krishnadasa, who also furnishes an introductory essay. There is another short introduction by Professor Humayun Kabir. These outline, briefly, the history and characteristics of Mughal painting over 200 years.

The miniatures illustrated, all from Indian collections, range from one of the Hamzah-Namah series, belonging to the Bharat Kala Bhavan, to an eighteenth-century version, related to some of the miniatures in the Wantage collection of South Kensington, of a well-known portrait of the Emperor Jahangir, the original of which is in the Chester Beatty collection.

Regarding the date of the Hamzah-Namah paintings, which form an important landmark in Indian Art history, about which the experts differ somewhat, Rai Krishnadasa relies on a statement of the historian Badayuni, which critics hitherto

seem to have overlooked, to prove that these were executed between 1567 and 1582. The evidence is not quite conclusive, but one can certainly agree that the series was completed at least as early as the latter date. Two of the plates are of miniatures in a fine and profusely illustrated manuscript of the Babar-Namah, of the late Akbar period, one miniature being dated 1598, acquired from St. John's College, Agra, by the National Museum, New Delhi. The Falcon (plate 4) from the Prince of Wales Museum, Bombay, is attributed to the famous Mansur, but it does not actually bear that artist's name. The *Camel fight* (plate 5), very Persian in style, is a less elaborate but much more vigorous presentation of this well-known subject than the one, attributed to the Persian master Bihzad, belonging to the Gulistan Palace, Tehran, which was closely copied in India by Nanha, and was itself related to an older original now in Istanbul[1]. Both group portraiture and individual portraiture are well represented by court subjects of the mid-century[2]. It is in this branch of painting that Mughal miniature art above all excels, and Western art, apart from that of Persia, especially in the first half of the seventeenth century certainly helped the Indian genius in its development. Perhaps both Professor Humayun Kabir and Rai Krishnadasa take too little account of the influence of Europe in the formation of the developed Mughal style. Europe supplied more than occasional hints in perspective and background colouring, though indisputably it is to India and Indian artists that the style, taking the whole period of its history, owes its main features. *At the well* (plate 9) from Sir Cowasji Jehangir's collection, though strongly influenced by Mughal art, is largely Deccani in style. It is an interesting and attractive miniature; it was shown at Burlington House in the Indian Exhibition of 1947, and it is a pleasure to see it reproduced here. The series deserves a cordial welcome.

J. V. S. WILKINSON

1. See *Persian Miniature Painting* by Binyon, Wilkinson and Gray, p. 130, plate 87, and *Ars Orientalis*, Vol. 1 (1955), p. 102 and figs. 3 and 63.
2. The drawing of the lady in Plate 7 is spoilt by the large hands and left arm.

SHORT NOTES ON OTHER BOOKS

ALPHABETS FOR SIGNWRITERS, ARTISTS AND ILLUMINATORS. *By H. Oxborough and W. T. Lovegrove. Technical Press*, 1956. 14*s*

In a greatly revised 21st edition of this book the authors have collected 64 examples of lettering. The book is divided into three sections: the first on Alphabets for manuscripts; the second, General purpose alphabets, and the last Miscellaneous alphabets.

SCRIBBLING, DRAWING, PAINTING. *By W. Grozininger, Translated by Ernest Kaiser and Eithne Wilkins. Faber*, 1955. 15*s*

Originally published in Germany, this book on child art now appears in translation, with an introduction by Sir Herbert Read. There are four colour and three monochrome plates.

MYSTERIES OF SCIENCE. *By John Rowland. Werner Laurie*, 1955. 12*s* 6*d*

That 'it may really be the believer in the completely satisfactory role of science as final explainer who is behind the times', is the theme of Mr. Rowland's book. There are many phenoma which, in the author's opinion, defy scientific explanation, and many problems which have never been realistically faced by scientists.

FROM THE JOURNAL OF 1856

VOLUME IV *23rd May, 1856*

From a paper on The British Silk Manufacture Considered in Its Commercial Aspects

The Exhibitions of 1851 and 1855 have done this good for the British silk manufacturers—they have created an appreciation of the real position of their fabrics as compared with those of France

This was apparent in the discussion, when free and frank acknowledgment was made to French superiority This is a hopeful sign, and betokens the right state of mind, from which improvement may be predicted It will always be impossible for a manufacture to improve when those engaged in it fancy they do well enough already that there is no goal beyond to reach I fully agree with the chairman, who after all pointed out the chief weakness to be remedied, when he said that the superiority of the French fabrics is to be referred to the superior intelligence of the workmen I do not mean to say, that English weavers are not intelligent, but intelligence is to be reckoned relatively, and it would be absurd not to allow the superior intelligence of the French weaver The fact is confirmed by his execution of difficult works, not in small quantities, or as pieces for show or curiosity, but as the staple of a province

There is a class of goods, for which the French draw all the world to their market, which owe their excellence to the intelligence of their workmen Till our workmen are raised by careful education to the same rank of intelligence as the French, we cannot expect to reverse the figures of exports and imports before alluded to We may glut all markets with our plain goods, but till a special as well as general education is afforded to our weavers to qualify them for their work, the French goods will still keep their deserved place in the esteem of all buyers of taste and refinement.

Some Activities of Other Societies and Organizations

MEETINGS

THURS 31 MAY Visual Education Council for 13 Suffolk Street Haymarket S W 1 p m J I W Ifen l n *Il ffr ation of Design*

MON 4 JUNE Geographical Society Royal South Kensington S W 7 p m Robert Steel *I on ns of Central and East Africa*

TUES 5 JUNE Incorporated Plant Engineers at the Royal Society of Arts W C 2 7 p m G I Victor Trott *Application f Liquid Fuel Firing*

THURS 7 JUNE Anthropological Institute Royal 21 Bedford Square W C 1 5 30 p m Bernard Fagg *Rock Paintings and Rock Gongs in Northern Nigeria*

Chemical Society Burlington House Piccadilly W 1 7 30 p m Prof G T Seaborg *Present Status of the Transuranium Elements*

Endocrinology Society for at University College Gower Street W C 1 5 00 p m Dr C N H Long *Some Studies n Experimental Obesity*

Naval Architects Institution of at Weir Lecture Hall, 10 Upper Belgrave Street S W 1 4 45 p m Commander P Du Cane *The Planing Performance, Pressures and Stresses in a High Speed Launch*

OTHER ACTIVITIES

NOW UNTIL 30 MAY Imperial Institute South Kensington S W 7 Exhibition of Current Issues *Commonwealth Postage Stamps*

NOW UNTIL 5 JUNE Imperial Institute South Kensington S W 7 Exhibition of Flower Studies *Paintings and Drawings by Bursary Students of the Harold W Sanderson Art in Industry Fund* (See also General Note p 528)

NOW UNTIL 3 JUNE Imperial Institute South Kensington S W 7 *Exhibition of Paintings and Drawings of Life in Northern India by Makhan Dutta Gupta*

MON 28 MAY UNTIL SUN 3 JUNE Imperial Institute South Kensington S W 7 12 30 p m 1 15 p m and 3 p m Weekdays 3 p m and 4 p m Saturdays 3 p m 4 p m and 5 p m Sundays Films *More Precious than Gold—South Africa*, *British Columbia—Canada's Evergreen Playground*

WED 30 MAY The Building Centre 26 Store Street W C 1 12 45 p m Film Show *Taking the Load (Building Plant and Machinery)*

WED 6 JUNE The Building Centre 26 Store Street W C 1 12 45 p m Film Show *Tiger I Excavators Wolf 11Jb Excavators*


THE ALOADAE

THE ROYAL SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES AND COMMERCE

PATRON: HER MAJESTY THE QUEEN

Full particulars relating to the work of the Society and conditions of membership and associate membership may be obtained from the Secretary.

The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

All other communications for the Society should be addressed to THE SECRETARY, ROYAL SOCIETY OF ARTS, 6–8 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2. Telephone number: Trafalgar 2366. Telegrams: Praxiteles, Rand, London.

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THE ROYAL SOCIETY OF ARTS, JOHN ADAM STREET, ADELPHI, W.C.2

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NO 4979 | FRIDAY, 8TH JUNE, 1956 | VOL CIV

FORTHCOMING MEETINGS

TUESDAY, 3RD JULY, at 2.30 p.m. '*Peaty Terrain: its influence as a factor controlling development in Great Britain and Canada*', by Norman W. Radforth, M.A., Ph.D., Professor of Botany, McMaster University, Ontario. (The paper will be illustrated with a film and lantern slides.)

WEDNESDAY, 4TH JULY, at 3 p.m. Annual General Meeting (see Notice below). Tea will be served afterwards.

ANNUAL GENERAL MEETING

The Council hereby gives notice that, in accordance with the Bye-Laws, the Two Hundred and Second Annual General Meeting, for the purpose of receiving the Council's Report and the Financial Statements for 1955, and the election of officers and the amendment of the Bye-Laws, will be held on Wednesday, 4th July, 1956, at 3 p.m., at the Society's House.

(By Order of the Council)

KENNETH WILLIAM LUCKHURST,
Secretary.

BURSARIES EXHIBITION

A small selection of the winning and commended designs in the Society's Industrial Art Bursaries Competition, which were included in the recent Exhibition at the Society's House, are at present on view at Falmouth School of Art, Kerris Vean, Woodland, Falmouth, Cornwall, where they will remain until 11th June.

The entire exhibition as originally shown at the Society's House will be exhibited in Belfast and Birmingham later this year.

EXCHANGE OF BENJAMIN FRANKLIN DOCUMENTS

The introduction of Benjamin Franklin to the Society of Arts came about through the forwarding to the Society by Dr. Alexander Garden of a copy of Franklin's 'Proposal for Promoting Useful Knowledge among the British Plantations in America'. This paper, in which Franklin set out proposals for the establishment of the American Philosophical Society was read to a meeting of the Society of Arts in June, 1755, when the plan 'was judged to be an excellent design if it can be put in practice', and it was decided that it should be preserved in the Society's Guard Book. Shortly afterwards William Shipley, the Secretary, wrote inviting Franklin to become a Corresponding Member, and Franklin agreed, saying that although as a Corresponding Member no subscription was due from him he wished to give to the Society 20 guineas, which was the amount of the life composition fee of an Ordinary Member.

These events have recently had an interesting sequel. The American Philosophical Society possesses no contemporary copy of the 'Proposal for Promoting Useful Knowledge', although it is virtually its foundation document, and recently approached the Royal Society of Arts with a view to effecting an exchange. The Council has now agreed to send the Society's copy (which is in manuscript) to Philadelphia and has accepted the generous offer of the American Philosophical Society to send in exchange a list of members of the Society of Arts in September, 1755, which was attached to Shipley's letter of invitation to Franklin, together with '1,000 Dollars as supplement to Franklin's original 20 Guineas'.

THE SOCIETY'S CHRISTMAS CARD, 1956

Particulars of the prices for the Society's Christmas card are now available, and are given on the order form at the back of this issue of the *Journal*.

AUTOMATION

A paper by

THE RIGHT HONBLE. THE EARL OF HALSBURY, F.R.I.C., F.Inst.P.,

Managing Director, National Research Development Corporation, a Member of Council of the Society,

read to the Society on Wednesday, 9th May, 1956, with the Right Honble. Lord Latham, J.P., F.A.C.C.A., F.C.I.S., a Member of Council of the Society, in the Chair

THE CHAIRMAN: I am greatly pleased to preside over this goodly gathering assembled for the paper we are to hear on 'Automation'.

Surely at this time few subjects could be more topical, or more in need of clarification, than that which has suddenly burst upon an unsuspecting public under the description of 'automation'. This word is now on the lips of the multitude, if only becaise of the unhappy events currently taking place in the industrial Midlands. In truth, the word 'automation' is in danger of becoming a sort of bogey; perhaps largely because it has passed into the currency of common speech before its meaning is properly understood. It is of national importance that automation should be understood for what it really is, and not for what it is misunderstood to be.

We are thus very fortunate to-day to have the Earl of Halsbury to help us, and the wider public outside, to a proper understanding of the real meaning, purposes and significance of these new or developed techniques now compendiously called 'automation'.

I know of no person better qualified to do so than he: for his wide practical experience in industrial engineering and his recognized scholarship and standing in the field of research as applied to scientific and mechanized techniques alike fit him, in an outstanding degree, to perform this valuable and important task. Lord Halsbury has held a number of positions of great scientific distinction, which I need not detail here; and he is at present Deputy Chairman of the Parliamentary and Scientific Committee and Chairman of the National Institute of Industrial Psychology. A most fortunate circumstance this latter: for psychological considerations will inescapably occupy a leading place in the successful acceptance of the application of automation by the workpeople, not only in the factory, but in the office as well: for automation will also push through the office door as well as the factory gate.

But whatever misconceptions may be current about automation, it is, I think, clear that application of the new and developed techniques it comprehends and their widening and intensified uses, which are demonstrably practicable, is bound to come. For they are in the direct line of progress; replacing man-power, both physical and mental, with machine-power, giving a vastly increased rate of productivity, with greater efficiency and economy. They cannot and, indeed, ought not to be resisted, for by and through them we can secure a rising standard of living at home, and bring broadening relief and succour to the millions of undernourished people in the world at large.

We may indeed be on the threshold of immense potentialities: of something in the nature of another industrial revolution and an era of multiplying prosperity. Encouraged as we may be by this beckoning prospect, let us not overlook that we are likely to be confronted with many problems and difficulties; for the widespread

application of automation will undoubtedly bring in its train great economic and social changes, transitional and permanent, in the design and structure of our economy in the pattern of our society. The social implications are many; and there will many initial dislocations in our existing economic set-up. The present distribution of labour and its skills between the skilled, the semi-skilled and the unskilled will change. A new rhythm of work may well emerge and develop; more leisure should become available, requiring us to work out a new rhythm for the place and enjoyment of leisure. Already in some quarters, where the only need for the worker is to supervise and watch, the question of loneliness has arisen. Then there is the physical strain of the tempo of operations, where man and the faster mechanical processes are in associated function. These are but some of the problems of adjustment which will arise. No doubt we shall resolve them in due time; sooner, I hope, rather than later.

Perhaps the most acute problem will be of the fear of redundancy and consequent under-employment or unemployment. We may think that there are no grounds for this, but it is there in the minds of workpeople. Nor will it be easily exorcized by the assurance that, as economic history seems to show, in the long run labour-saving techniques provide more employment and not less. The fear of unemployment, however, is an immediate and personal one, and the worker's experience of the past is still too near for him to disregard it. Nor is the distribution of excess labour in one place to other places an easy answer; for workpeople have their deep social roots where they live, which cannot be lightly torn up without regret or protest, even if the present housing situation easily permitted them freely to move around.

In short, who is to bear the transitional burden of automation and who is to enjoy its fructifying benefits? It will, I think, be no more than social justice to recognize, as a claim on the benefits ensuing, some reasonable and proper provision for relief of any actual hardships, if they arise from redundancy directly due to automation. Furthermore, the benefits as they fructify should be fairly distributed between owners, workpeople and consumers, remembering always that we are all consumers and also, of course, that we are all citizens. If the enjoyment of the rewards of automation are known to be and are seen to be shared in a just and equitable way then all persons of goodwill can be fairly expected to co-operate in seeking the maximum results from this, yet another, stride forward on the road of progress.

I trust you will pardon my rather lengthy interposition between you and the lecturer, for it is he whom you came to hear, not me. I hope I have not impinged unduly upon what he has to say. But in the thickening confusion that surrounds the subject of automation I felt entitled to express one or two thoughts of my own: maybe at the risk of adding to the confusion! Indeed, I believe that Lord Halsbury may well disagree with much of what I have said: if so, then it may add to the interest and, perhaps, the gaiety, of this afternoon's proceedings!

The following paper was then read:

THE PAPER

I shall assume that you have all heard the word 'automation', but I shall not assume you all know what it means. In fact, it is widely used in so undefined a sense that the few people who claim to know what it means rarely find themselves in very satisfactory agreement with rival claimants to the same knowledge. My first concern will therefore be to make it clear what I am talking about.

I will begin by saying that we are concerned with the relation between sub-species and species. Automation is a sub-species of which 'mechanization' is the species. I think you all know what I mean by 'mechanization'. It consists of substituting machine activity for human activity. 'Substitution' is what we

are concerned with. If there is no 'substitution', then the word 'mechanization' is inappropriate. A telephone for example is not a 'mechanization' of anything but an automatic telephone exchange is, because human switchboard operators are replaced by an electromechanical set of devices.

Automation being regarded accordingly as a sub-species within the species 'mechanization', what defines it? I think I can give a fairly satisfactory answer by stating that where we are mainly concerned with finding a substitute for nerve and brain we can talk of automation, but where the process concerns mainly muscle and brawn we can talk of mechanization. Since all nervous activity is manifested finally in muscular activity the distinction cannot be a hard and fast one, but you may picture the muscles for which a substitution is effected by automation as those of the fingers, larynx and eyeball rather than those of the biceps, shoulders and thighs, the substitution of which is effected by mechanization in the narrow sense of the word.

Why have we suddenly found the need to coin a new word—automation—to describe this group of substitutions? Has a new technique emerged? I think that if only one new technique had emerged we would not have coined a new word to describe it. The fact is that a group of techniques has matured fairly recently and, though they have little in common technically, their overall effects have that something-in-common which requires a word to describe it. The word 'automation' as used to describe a group of independent techniques was, in fact, borrowed from the first of them to achieve industrialization. This group is sometimes called 'Detroit automation' or transfer machining. I ought to add that the process is not new and did not originate in Detroit. It applies typically to the operations involved in machining the cylinder block of an automobile engine. These are customarily carried out by a sequence of machining operations effected in automatic machine tools.

The top and bottom of the cylinder block must be planed, milled or broached flat and parallel*. The cylinders must be bored. Valve guides must be drilled and valve seatings bevelled and ground. Bearings for crankshaft and cam shafts must be machined. Various flats for mounting auxiliary equipment must be milled and bolt holes drilled and tapped. Machine tools designed to do these individual operations are expensive and idle time on them is costly. The improvement of these tools beyond the point where they can cut faster than a human operator can set the work up to be machined is obviously uneconomic, for faster machines would spend an undue proportion of their time waiting for work to do.

In 1923 Morris Motors first attempted to tackle the problem of feeding work into and out of machine tools automatically. The experiment was technically but not economically successful. The machine tools of 1923 were not fast or costly enough for the time saved in mechanizing their input and output to pay an adequate dividend on the cost of mechanizing the transfer process.

Twenty years later the Ford Motor Company of Detroit repeated the experiment with altogether different results. This was not because they were cleverer or more persevering than the Morris Motor Co. of 1923, but because

* In the case of a V-engine, the top of the cylinder block will consist of two inclined faces.

the capital costs of machine tools had risen in the interval due to the use of harder cutting tools which could be employed to cut at higher speeds. The technical problem of mechanization was unchanged; the economics of the substitution had changed out of recognition. As so often happens a local nickname was given to the project at Fords. Automation was the name that stuck. From Fords it spread to the rest of the automobile industry and from the automobile industry to industry generally, which uses it to describe a variety of processes having little in common with one another technically. The pressed steel bodies of automobiles are prepared by a sequence of stamping operations, between each of which a partly formed blank has to be handled by human operators. Just as Detroit automation can be quite properly described as transfer machining, so the mechanization of these intermediate handling operations can be described as 'transfer pressing', and the generality of all such substitutions as 'transfer processing'. All may be popularly described as one of the techniques included under the general heading—Automation.

You can readily see that the techniques of 'transfer machining' and 'transfer pressing' involve characteristically different problems. There is little in common between manipulating a rigid object like a cylinder block into very precise register underneath a multiple boring machine and manipulating an awkward floppy object like a large piece of sheet metal into approximate register under a press-tool. Certain strategic problems are however common to both. For example, it is uneconomic to complete a whole sequence of operations and reject the finished work because of a fault due to the first of them. With automatic transfer there must be automatic inspection, involving the twin problems of how to effect it and how often and where to apply it.

Again there is the problem of breakdown. Nothing works perfectly. A tool tip may wear or break. A press die may wear or be damaged. Is a whole sequence or transfer line to become immobilized because of a halt at one single point? If not, it must be broken up into sections at each one of which a buffer stock of partly-finished work must be held. Into how many such sections should such a line be divided and how much work should be stored at each? These sort of problems ought to be a happy hunting ground for the industrial mathematician employing the methods of operational research, theory of games, linear programming and theory of queues.

I feel I have now given a picture of a push-button factory with a river of castings flowing in and a river of finished engines flowing out. Let me however assure you that such a picture is false. Push-button factories are like space-rockets, and push-button manufacture is like space-travel. There are no realizations of such fictional concepts even if industrial journalists cannot resist the temptation to dramatize them in advance of achievement.

May I accordingly introduce you to a simple economic consideration in this field. The terminal phase of any substitutive process such as automation operates under the law of diminishing returns. The first stages to be tackled are those which are either technically easiest or economically most remunerative or those which represent a compromise between the two *desiderata*.

Suppose for instance that a sequence of processes requiring 100 human operators can be transformed into five blocks of twenty sequences each, each sequence being integrated by transfer processing. Ninety-five human operators will be eliminated by this reconstruction. Five will remain, the five required to transfer work between the five blocks. These last five operators will almost certainly be concerned with transfers which would be technically or economically unattractive. It is almost certain that some other process would at this stage compete for the attention of production engineers.

You can now see why push-button factories are science fictional. Machining cylinder blocks was economically rewarding and technically feasible and production engineers accordingly turned their attention to it. They did not however go on to try and assemble complete engines automatically. They diverted their attention elsewhere and tackled the problem of transfer pressing of automobile bodies. Automatic assembly in this field is too difficult to be attempted as yet. For this reason techniques of automation constitute a patch-work within the pattern of general manufacture. For as far ahead as can be foreseen there will be, at most, push-button processes, but not push-button factories.

I have now introduced you to the historically first of the techniques which are grouped together and described as automative. Automation—automative—I regret that those who coined these new terms did not include a philologist. The adjectival form 'automative' provides a useful contrast with the colloquial use of the word 'automatic'; but what of the verbal? Does one 'automate' or 'automatize'? I suggest the following classification of the words involved, though I cannot pretend to any canonical authority for doing so.

		Traditional/Colloquial	*New/Technical*
Verb transitive	...	Automatize	Automate
Adjective ...	..	Automatic	Automative
Abstract noun	...	Automatization	Automation

You will remember that I suggested the substitution of nerve and brain rather than muscle and brawn as characterizing automation. In transfer processing nerve is at a minimum and muscle at a maximum compared with the other processes which I will be discussing. Remembering that the easiest processes are those to be tackled first, this contrast is understandable. Do not however forget one criterion which indicates that nerve and brain are involved in Detroit automation: there cannot be automatic transfer without automatic inspection; here lie the elements of nerve and brain involved.

The second great group of techniques to which automation can refer involves automatic assembly. Automatic assembly is not new. You can, if you wish to be pedantic, regard a loom as a device for automatically assembling a piece of cloth. Some would quarrel with so extensive a scope being given to the idea of automatic assembly, but they would certainly agree that it could be applied to the manufacture of electric lamp bulbs, and that such manufacture, though highly automatized, is not new. Lamp bulbs radio valves and cathode ray tubes—

they followed in that order; but the production of a complete amplifier went so much further that it seemed justifiable to give it a new word and automation was extended to include such production.

The first stage was to fabricate the electrical connection as a separate unit. This was achieved by the technique known as 'printing circuitry'. Essentially, a conducting pattern is laid on an insulating board. There are many ways of doing this. A common, the most usual, method in fact is to lay a copper foil on to a plastic backing plate and to print a pattern on the compact with an etch-resisting ink. The compact is then etched leaving a pattern of copper-foil conductors bonded to the plastic. A variant known as the negative process is used where a conducting pattern is required on both sides of the board and connections have to be made through from one side to the other. According to this variant the plastic board is clad with copper foil on both sides and a negative of the pattern required is printed on each side. Holes are then punched at the points where the connections are required to be made through the plastic from the pattern on one side to the pattern on the other and the whole placed in a copper-plating bath. Copper is deposited on both faces and creeps through the holes from one side to the other, according to a convenient property of copper plated in this way. When the connection is established, the work is transferred to a tin-plating bath and the exposed portions of the copper including the holes are tin plated. The ink used as a resist is then removed and the compact treated with a differential etchant which removes copper but not tin. Like all wet processes of this kind, photographic, photolithographic, electroformative, and so on, printing circuits sounds complex when described verbally. It is quite simple to perform however, and the process does not look complicated when you see it broken down into technical operations which can be observed.

The connecting circuit being established in this way, there remains the problem of assembling the components in register thereon. This is essentially a stapling operation and the unit operation does not differ materially from that used in a very familiar office gadget, the stapling clippers which pin dockets of paper together.

An electrical component, be it resistor or capacitor, is commonly a cylindrical element with two opposed axial leads in tinned copper. These are conveniently mounted on expendable tapes wound on a feed drum, the whole being somewhat reminiscent of the belt feed of bullets to a machine gun. A sequence of such drums is mounted at stapling stations on the assembly line and, as the printed circuits boards are fed in register on a conveyor belt under the various work-stations, feed and stapling action comes into play and each board acquires its complement of circuit elements as it traverses the various work-stations. All components being stapled in register through holes in the printed circuit board, the latter is dipped into a soldering bath and all the stapled connections soldered firmly together in one operation.

The successful achievement of processes as complicated as the foregoing represents a substitution of human eyes and fingers. The component of nerve and brain displaced is greater in proportion to the displacement of muscle and

brawn than in the case of transfer machining. If one may properly be called automation, so may the other on the definition of automation used here. The number and variety of the problems to be solved exceeds that involved in manufacturing lamp bulbs by such a large factor that a qualitatively new feature seems to be genuinely present. Such being the case, the achievement goes further than the mere manufacture of amplifiers for deaf aids, radio receivers and television sets. It is an inspiration to production engineers who will now perforce ask themselves in how many other fields comparable achievements may be awaiting discovery.

In my third example of automation the component of nerve and brain eliminated is greater still. I refer to the whole group of techniques known as control engineering. These are not new, but have undergone remarkable evolutionary acceleration in recent years. Centrifugal governors were first used in corn-grinding machinery. James Watt adapted—and patented—a modification of such centrifugal governors to steam engines. Speed governors, thermostats, auto-pilots: these all belong to a family of devices having certain features in common.

First they all contain some quantitative measuring device which indicates the appropriate quality to be regulated: speed, temperature, direction, and so on. Secondly, they possess a device for 'setting' the regulator by selecting some particular value of, for example, speed, temperature, or direction which is to be maintained constant. Thirdly, they contain a subtractive element which indicates the error between the desired and the actual performance to be regulated. Fourthly, they contain a regulating element operated by the 'error' signal generated as described above in such a way that a correction is introduced adjusting the performance to bring it into conformity with the setting. Thus steam is turned on if velocity is too low or off if too high; a source of heat is turned on if the temperature is too low or off if too high; rudder is applied to the right if the boat, aeroplane, missile, or whatever it may be, is off course to the left and to the left if it is off course to the right. I must now refer to the advances in this field; they are twofold: theoretical and practical.

A characteristic of all these self-regulating or negative feed-back elements is that they 'hunt' or oscillate about the desired setting. In certain circumstances this hunting may be dangerous. The unskilful driver of a motor car can be regarded as an unstable control element; the car yaws to left and right of its course. Those who can sail a boat will be aware that it is much more difficult to sail a boat skilfully into a variable wind than to drive a car along a twisting road. The sailing boat has two settings, that of the sheets and that of the tiller and they interact in such a way that a course into the wind easily degenerates into a series of cusps, in which the boat comes too close to the wind and loses way before paying off. Automatic regulation by means of two interacting controls is more difficult to stabilize than regulation by means of a single control. An example of instability is provided by the yawing of a towed vehicle such as a trailer caravan. If well designed, the system (vehicle/tow-bar-linkage/trailer) should be stable and the trailer should follow the vehicle faithfully. At critical

speeds, however, a trailer may commence to yaw and the amplitude of this oscillation may build up to the point where a disaster occurs and the trailer overturns. Imagine that instead of the direction of a trailer we were concerned with the neutron flux in an atomic reactor, or the plate hold up in the fractionating column of a big oil refinery, and you will see how very disastrous instability can be. Necessity is the mother of invention. Guided missiles with their multiple controls, oil refineries with their multiple feed backs and atomic reactors with their potentially high-speed response to divergent conditions have, of recent years, presented problems bristling with intractable mathematics and a method of solving them has had to be evolved. This involves building electronic models of the systems involved, models which, in essence, are describable by the same intractable mathematics as the original systems. The behaviour of these models then provides an alternative to the numerical solution of the mathematics. Models of this kind are known as analogue computers and their evolution and successful construction and study have led to notable advances in the theory of the subject.

The practical side has been associated with the development of electronics. May I present two alternative uses of an electrical assembly. It can be thought of as a source of signals, or it can be thought of as a source of power. In automatic control we are concerned with both. Physical conditions of heat or light, temperature, pressure, stress, torque, and so on, can all be made to generate electrical signals. These usually take the form of small voltage changes at a low power level across a load resistance. These signals require in general to be processed as input signals and delivered as output signals after processing. By processing I mean that some sort of a signal or pattern of signals 'in' has to be converted into some other sort of signal or pattern of signals 'out'. The output signals have finally to be amplified in such a way as to generate power in quantities sufficient to work regulators. Electronics enters into this operation in two ways. Firstly, the electronic amplifier is usually an essential stage in the output process of raising the power level of a signal to the point where a regulator can be brought into action. Just as important, however, as power amplification is the use of electronic circuitry for the processing of signals, that is of converting one pattern into some other pattern. One can see the importance of this in an intuitive way, but why is electronics important as a means to the end? The reason is a simple one, though it is not usually given in the form in which I prefer to see it stated. Electronics permits a divorce of functional from spatial distribution of component elements that is without precedent in mechanical terms. In any mechanical assembly function and geometry are inextricably linked. A wheel must rotate about its geometrical centre, a lever about its geometrical fulcrum; the teeth on a gear wheel must not only have number but precise configuration in space; a shaft cannot be bent round a corner without four bearings and two crown wheels; parts which are functionally sequential must be spatially contiguous; and so on. The designer of a mechanical information processing device of more than a limited degree of complexity is thus beset with the difficulties inseparable from the fact that two pieces of matter cannot be in the same place at the same

time. What he finally designs, as in cam-operated predictor equipment, has to be fabricated with extreme precision. In the electronic counterpart of any such device all these difficulties disappear, permitting an increase in the complexity of the devices which can be fabricated for the same design and development effort. It is true that other difficulties arise to replace them; for example, a metallic part remains the same size throughout its history, whereas electronic components drift in value, or tend to. But these difficulties do not affect permissible complexity directly so much as a certain kind of reliability, namely the number of occasions when a part requires to be replaced. This, of course, may have an indirect effect on complexity in so far as the latter may entail a physical multiplication of essential units. These must not be multiplied to the point where at least one is always out of action. Fortunately this limitation is not encountered until after electronics has accomplished a notable advance on any signal processing device achievable without prohibitive complexity or expense by mechanical means.

I feel that these descriptions are somewhat abstract and that a concrete illustration of an automatic control system would be appreciated. In this context I would invite consideration of the operation of a big modern oil refinery. There you will find chemical and thermal feed-back loops of a complexity such that no man could visualize the effect of his intervention *seriatim* at all the control points without being thrown into a state of mental confusion. All these points will be found to be under the control of automatic regulators linked and coupled in such a way that human intervention is largely unnecessary. The result, you will find, is stable. Stripping columns do not surge. Only a small handful of skilled operators will ever be found engaged in working the plant. For the most part, though they are conventionally referred to as 'labour', they have little to do except wait for something to happen which requires personal intervention. The handful who operate the plant are outnumbered many times by the skilled fitters and engineers who maintain it and replace corroded or mechanically worn parts. Labour in the classical sense has simply disappeared. There is no unskill; it is all skill.

May I now turn to the fourth and last group of techniques included under the name of automation: information processing techniques made possible by the achievement of the electronic digital computer. The component of brain and nerve replaced is here at its maximum relative to the displacement of muscle and brawn. In contrast to the techniques of automatic control which commence with information and end with power-operated servos, data processing or information handling starts and ends with information. There is no final stage of power amplification. Automation in this context provides a partial substitute for the brain of the accountant. For this reason electronic computers are sometimes called mechanical brains. If you care to call a mechanized grab a mechanical hand, you are of course free to do so, if you consider it appropriate on the grounds that it does work for which a hand would otherwise be required. By the same token you can call an electronic computer an electronic brain if you think it appropriate for a cognate reason. Only be clear that they are not brains, are not

of AGI, who was introduced by Mr. Ashley Havinden, President for Great Britain. Following the showing in Paris last year, the Exhibition presents, in an eminently clear display, examples of the work of internationally recognized advertising artists from 11 countries. The Exhibition, at the R.B.A. Galleries, Suffolk Street, Pall Mall, is open daily from 10 a.m. to 7 p.m. on Tuesdays to Fridays, and from 10 a.m. to 5 p.m. on Mondays, until 30th June. An introduction to the Exhibition catalogue, written by Mr. Charles Rosner, is reproduced below by kind permission of the author and of the Alliance Graphique Internationale:

The days of the Renaissance had their craftsmen and artists, typical manifestations of spiritual and material riches. In our day industrial and technical developments have made their mark in the field of communication through advertising, calling for the skilled designer who can work in a functional fashion and achieve a result of the highest artistic level in fulfilment of his complex function. Art and commerce must come to terms with each other, and our mid-twentieth century mentality has found a logical expression in AGI—Alliance Graphique Internationale.

Throughout the ages, artists have always been most independent by nature and even among individuals their independence is the most tenacious of all. Yet, generally speaking, they have no objection to collective membership of a school of painting if it can bring about the recognition of school or trend more effectively than the efforts of a lone individual member. How was it that a number of designers and artists banded together as AGI in spite of the fact that they came from many countries and did not belong to the same school, either nationally or internationally?

They were brought together in the first place by an awareness that their colleagues were faced with the same or similar circumstances or problems, irrespective of country. Six years ago an exhibition of the work of five artists—three French and two Swiss—toured Switzerland, and out of their friendly meeting in 1950 in Basle grew the idea of AGI. A casual, spontaneous but intermittent exchange of problems, experiences and views gradually fell into a recognizable pattern, and it became obvious that they should be brought together within a formal framework to the advantage of all those actively and passively concerned with and interested in design in advertising in its widest expression.

AGI was officially formed in Paris in November, 1952, under the presidency of Jean Picart le Doux. The aim was to improve and foster mutual understanding between leading designers throughout the world, both from the artistic and economic point of view. Much ground has been covered in a short time. For instance, in April, 1955, AGI organized a remarkable international exhibition on a large scale in Paris entitled *Art and Advertising in the World*. Jean Carlu, their current President, said that the Exhibition was not only a remarkable collection of works of graphic art from all the corners of the world. It stressed, above all, the æsthetic affinity uniting the work of AGI across oceans and continents, in spite of different psychological 'climates'. It showed the work of 74 artists, including 22 guest exhibitors; it represented 11 countries, and it was held in the Pavillon de Marsan of the Louvre.

AGI exhibitions are noteworthy as each member-designer has entire independence of choice of exhibit—a way of expression within the framework of a collective expression. Each designer stands for the exhibit of his choice and the group as a whole stands for the level which is created by the cumulative impact of individual exhibitor and exhibit. AGI necessarily limits accession to its ranks through the election of new members by existing members, but it gives full freedom to members once they have been elected.

Here is a free confederation of design on an international scale. What are the benefits to advertisers, to its members and to the world of advertising at large? When the selection of exhibits is his responsibility—and obviously he will display

his most resolved work—the artist can pay a grateful tribute to those of his advertising clients who have given him the opportunity of a free hand to express himself at his best for the sake of the advertiser. The designer can enjoy the benefit of a free and uninhibited interchange of outlook and experience with his colleagues in other countries. As for the benefit to advertising at large, such exhibitions can prove to non-believers that striking results can be attained in present-day advertising art without stepping down from intellectual and artistic levels and execution of high standards. The exhibits are a convincing proof that the visual expression of clear thinking, intellect, and imagination is not restricted to any particular style. Success may be due to the creation or employment of abstract shapes and rhythm of forms, masterly lines of the versatile hand, brushwork worthy of the experienced painter, letter forms worthy of the top-flight typographer, or it may be due to a combination or variation of several such methods. The successful designer must be able to answer two vital questions—the exact purpose of any given piece of advertising communication, and the best way to give it convincing effect.

When exhibitions of this nature are international rather than national the main conclusion is bound to be more conspicuous. The AGI Exhibition in London shows a common pattern. This particular approach to and solution of the complex problems of modern advertising communication are not confined to a few advertisers, or to a few artists, or indeed to a few of either in any given country. The amazing triumph of the AGI Exhibition in the Louvre did not only find expression in laudatory articles in the French and international Press. Not only did advertisers and designers go to see their own work or the work of their competitors, but a surprisingly high number of members of the lay public were interested enough to see the Exhibition and pay an entrance fee, in spite of the fact that many of the exhibits had been on view to the public on hoardings, in newspapers, and in periodicals in many countries.

In those weeks in Paris, the main topic of conversation was not concerned with one exhibitor's merits against another's or with one designer's work compared with another's. It centred excitedly round the fact that advertising at its best had gained the distinction of admission to and acceptance by a museum of applied art with such a great tradition. AGI had passed a formidable test. Museums apply two yardsticks in deciding the fate of potential exhibits: what is their worth from the historical point of view and what is their worth in the present day?

Advertising design—not only the exhibited design, but the actual method of display—found a rightful place among other expressions of contemporary applied art. Significantly the technical execution of multiplication equalled the standards of conception, a vital element in the success of any piece of advertising.

The London Exhibition of AGI, following as it does so closely on the heels of the showing in Paris, will give the English advertiser and the English onlooker—both less emotional than the French—a fair chance to see for themselves whether our designers for advertising are given the same scope as those in foreign parts. If the interest of the English in these exhibits is as rewarding as that of the French, then the question will arise whether those responsible for setting the standards for design in advertising do not underrate the artistic and intellectual receptivity of the English public at large.

RED CROSS LECTURE

A lecture on 'How we hear and how we see' is to be delivered by Sir Lawrence Bragg, O.B.E., M.C., F.R.S., at the Royal Institution, Albermarle Street, London, on Tuesday, 3rd July, 1956, at 8.15 p.m. The lecture, which will be illustrated by experimental demonstrations, is in aid of the British Red Cross Society, County of London Branch, and admission will be by ticket only. Tickets, at £1 1*s*. 0*d*., 15*s*., 10*s*. 6*d*., and 6*s*. 6*d*., should be obtained in advance from: The Branch Officer for Appeals, County of London Branch, B.R.C.S., 6 Grosvenor Gardens, S.W.1.

OBITUARY

THE RIGHT HONBLE. LORD PERRY

We record with regret the death, in the Bahamas on 17th June, of Lord Perry, at the age of 78.

The Right Honble. Sir Percival Lea Dewhurst Perry, Baron Perry of Stock Harvard, in the County of Essex, K.B.E., LL.D., F.R.G.S., M.I.Mech.E., was educated at King Edward School, Birmingham. After a short time in a lawyer's office, he moved to London, where he entered the motor trade, and was instrumental in introducing the Ford car into this country at the beginning of the century.

A visit to the United States, and meeting with Henry Ford, led him to form the Ford Motor Co. (England) Ltd., in 1909. In 1928 he handled the reorganization of the Ford European interests, this resulting in the formation of the present Company, and the building of the Dagenham factory. He was Chairman of the Company until his retirement in 1948, and also held that position in the Ford Motor Companies of a number of other European countries. He was also a director of the National Provincial Bank Ltd., and from 1914 to 1916 president of the Motor Trade Association. Among other businesses founded by him was the Slough Estates, organized in 1920. The wartime Slough depot was thus converted into a prosperous industrial estate.

During the First World War he worked voluntarily in various government departments, employing his own staff. At the outbreak of the Second World War he became business adviser to the Ministry of Food, resigning in 1940. Interested in farming and in the arts, he founded the Fordson farms, an experiment in co-operative farming, and published several books, among them *International Trade Balance*, and a volume of poetry, *O.K. Verses*.

He was appointed C.B.E. in 1917, and created K.B.E. in the following year, being raised to the peerage in 1938. He also received many foreign honours. Lord Perry was elected a Life Fellow of the Society in 1947.

SIR FRANK BRANGWYN

We also record with regret the death, in Sussex on 11th June, of Sir Frank Brangwyn, an Albert Medallist of the Society.

Frank William Brangwyn, R.A., R.P.E., Hon.R.S.A., LL.D., University of Wales, was born in Bruges in 1867. Brangwyn's early years were spent in Belgium, but on the family's return to England he worked at the Victoria and Albert Museum, and at the age of 15 was brought to the notice of William Morris, who employed him on making cartoons for textiles. In 1885 Brangwyn's first painting *A Bit of the Esk* was exhibited at the Royal Academy. The sale of the picture encouraged him to leave his work in London, and he went to sea as a cabin boy; his subsequent travels had a considerable influence on his style.

Yet, although Brangwyn continued to paint easel pictures, and to exhibit at the Academy, he early developed along the lines by which he is best known, that of mural painting; and of his murals those originally commissioned for the Royal Gallery of the House of Lords in 1925, and now in the Brangwyn Hall at Swansea, first made his name widely known. His murals were commissioned for many London buildings, and examples of his work are to be found all over the world. Some of his largest murals are in the United States, Canada, and Mexico, while Bruges, and Orange in France, have Brangwyn Museums.

Brangwyn was an extraordinarily versatile artist. Apart from his mural painting, he practised most of the visual arts and crafts from architecture to book illustrations.

He designed the British Pavilion used for the Biennial Exhibitions in Venice, and the *façade* of the Rowley Gallery in Kensington. In 1930 a comprehensive exhibition of his furniture, pottery, carpets and interior decorations was held in London, while in 1935 was published *The Way of the Cross*, an interpretation in 12 drawings of the Stations of the Cross, with a commentary by G. K. Chesterton. In 1952 he became the first living artist whose works were chosen for a retrospective exhibition in the Diploma Gallery of the Royal Academy, and a note on this, by Mr. Nevile Wallis, was published on page 831 of the *Journal* for 31st October, 1952.

In 1932 the Albert Medal was awarded to Brangwyn 'for services to decorative and commercial art', and in the letter which accompanies the medal the Duke of Connaught, then President of the Society, said 'your mural paintings adorn many of our great buildings . . .; your numerous etchings of industrial subjects have marked you out as one of the greatest etchers of our time; you have distinguished yourself as a designer of furniture, posters and stained glass windows, and numerous as are the branches of art which you have practised, you have proved yourself a master in every one of them'.

Brangwyn was knighted in 1941. Among his many positions were the Presidency of the Graphic Arts Society and the Vice-Presidency of the Association of Architects and Surveyors. He also received numerous foreign honours.

DR. J. M. COPLANS

We also record with regret the death, in Cape Town recently, of Dr. J. M. Coplans, who was drowned while bathing.

Joseph Moses Coplans, L.R.C.P., L.R.C.S.Ed., was born in Canterbury in 1888. He was educated at Simon Langton School, and served as a captain in the R.A.M.C. during the First World War. Later, he was director of dental services at the King Albert War Hospitals, and senior honorary surgeon to the Dental Hospital at Johannesburg.

Dr. Coplans was also a sculptor, and his bust of Bernard Shaw is now in the British Museum, while others of his works are in the National Gallery of Ireland, the Togg Museum at Harvard, and the Kruger Museum, Pretoria. He also contributed a series of cartoons to the *Jewish Chronicle*.

He was elected a Fellow of the Society in 1951.

NOTES ON BOOKS

THE ENGLISH HOME. *By Doreen Yarwood. Batsford*, 1956. 45*s*

Mrs. Yarwood is to be congratulated upon the admirable idea behind this impressive history of the English domestic interior and upon the tremendous amount of work that has gone to its fulfilment. The idea is to classify, explain and illustrate the furniture, the equipment and the details appropriate to each of ten main periods, beginning in the seventh century with Anglo-Saxon and ending in 1914 with Edwardian and, on the basis of these components, to reconstruct in drawings complete rooms of each period.

The great majority—indeed 731—of the illustrations are line drawings. Mrs. Yarwood makes it clear that this concentration on drawings, at least as far as the complete rooms are concerned, is an essential part of her conception of the book; for only in a drawing can she be certain of showing an interior entirely of one period. No doubt this is true enough, but there is a certain inhumanity about any ordinary room which is all of a piece, which has inherited nothing from its past—I say 'ordinary room', because I am sure that this does not apply to the classic and disciplined

splendour of, for instance, Syon House. I find the line drawings in this book rather hard and unsympathetic; they provide an adequate presentation of individual pieces of furniture but fail to give an impression of the character and atmosphere of a room; indeed, they emphasize the essential inhumanity of a one period interior. Incidentally it would have made the book a great deal more useful as a work of reference if the source of the illustrations had been given.

It is perhaps unfortunate to end a history of domestic interiors at so desperate a moment as 1914; after all, some fine new rooms were produced in the 1930s, and one or two of these could have left readers with a ray of hope for the future.

But in spite of these criticisms this is not only, as Mrs. Yarwood intended it to be, a useful work of reference for students; it is also of great interest for the general reader.

R. D. RUSSELL

FROM THE JOURNAL OF 1856

VOLUME IV. *27th June*, 1856

THE SOCIETY'S FIRST EXAMINATIONS

From the Report of the Fifth Annual Conference of Institutions in Union.

It will be remembered that one of the objects laid down on the original formation of the Union in 1852 was, 'that the Institutions be assisted to become also places of systematic instruction, with systematic examinations, and certificates of the results of studies'. This the Society has endeavoured to carry out by establishing a system of Examinations. The first Examination was held in the Society's rooms on the 10th, 11th, 12th and 13th of this present month of June, under the direction of an acting Board of Examiners* consisting of the following gentlemen:—

Mr. Ball, Mr. John Bell, Dr. Bernays, Rev. Dr. Booth, F.R.S., Professor Brasseur, Professor Brewer, Mr. C. Brooke, M.A., F.R.S., Professor Browne, Mr. James Caird, Dr. W. B. Carpenter, F.R.S., Mr. F. S. Cary, Rev. S. Clark, Rev. Dr. Elder, Rev. W. Elliot, Mr. Glaisher, F.R.S., Professor Henfrey, F.R.S., the Dean of Hereford, Mr. G. H. Jay, Dr. Bence Jones, F.R.S., Mr. J. C. Morton, Rev. A. Bath Powers, M.A., Mr. F. R. Sandford, Professor Solly, F.R.S., Dr. Stenhouse, F.R.S., Rev. F. Temple, Professor John Wilson, F.R.S.E.

There were 52 Candidates. The subjects in which the Examination was held were as follows:—Mathematics, Book-keeping, Mechanics, Chemistry, Physiology, Botany, Agriculture, Geography, English History, English Literature (including English Composition and Writing from dictation), Roman History and Latin, French, German and Free-hand Drawing in outline from objects.

All the Candidates were tested by a preliminary examination in writing and spelling, and unless this examination was satisfactorily passed the candidates were not allowed to attend the other sections of the Examination. Of the 52 Candidates only two were rejected on this head. The Examiners have been much gratified to find that in the greater portion of the subjects the general standard of information disclosed is higher than had been anticipated. The Society's certificates are of three grades: the first for 'Excellence', the second for 'Proficiency', and the third for 'competency'. The details, however, of the examinations, will be given in the Examiners' Report.

* who gave their services voluntarily and examined all the candidates orally [Ed.]

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THE ROYAL SOCIETY OF ARTS

JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

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PRESIDENT : HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH, K.G.

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Candidate's Name in full

Nationality

Address

Rank, Profession or Business

I desire to become a Fellow/an Associate Member of the Royal Society of Arts.

Signature of Candidate

Date of Birth

We hereby propose and recommend the above Candidate as a fit and proper person to become a Fellow/an Associate Member of the Royal Society for the Encouragement of Arts, Manufactures and Commerce.

Signatures of three Fellows, at least one of whom must sign on personal knowledge :

Name in Block Capitals	Signature
[ ]	*(on personal knowledge)*
[ ]	
[ ]	

Read and suspended

Elected

P.T.O.

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Full particulars relating to the work of the Society and conditions of membership and associate membership may be obtained from the Secretary.

The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

All other communications for the Society should be addressed to THE SECRETARY, ROYAL SOCIETY OF ARTS, 6–8 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2. Telephone number: Trafalgar 2366. Telegrams: Praxiteles, Rand, London.

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LONDON
THE ROYAL SOCIETY OF ARTS, JOHN ADAM STREET, ADELPHI, W.C.2
PRICE TWO SHILLINGS AND SIXPENCE

R.S.A. PUBLICATIONS

The following are some papers and lectures read to the Society in recent years. Copies of the *Journals* in which they were published are obtainable on application to the Secretary Fellows are allowed a discount of 25 per cent. Lists of titles of papers and lectures read in earlier years are also obtainable on application.

THE SAFETY FACTOR IN CONSTRUCTION (Two Lectures) G. A Gardner and Professor F. S. Thompson	2/6
THE NOVEL (Three Lectures) Dennis Wheatley, Michael Joseph and Christina Foyle	3/6
THE KEMANO-KITIMAT HYDRO-ELECTRIC POWER DEVELOPMENT F. L. Lawton	2/6
THE ASCENT OF EVEREST Wilfrid Noyce	2/6
WEATHER MODIFICATION AND ITS VALUE TO AGRICULTURE AND WATER SUPPLY Dr. Irving P. Krick	2/6
SAFETY IN TRANSPORT (Three Lectures) Dr. W. H. Glanville, Sir Vernon Brown and Lieut.-Colonel G. R. S. Wilson	3/6
COLOUR TELEVISION BROADCASTING C. G. Mayer	2/6
THE DESIGN OF NEW SCHOOLS C. H. Aslin	2/6
LETTER DESIGN AND TYPECUTTING Harry G. Carter	2/6
LIFE IN THE YEAR 2000 A.D. Two prizewinning essays	2/6
SCIENCE AND FOOD PRODUCTION Dr. L. H. Lampitt	2/6
RESEARCH IN THE COAL INDUSTRY Dr. Idris Jones	2/6
THE COPPERBELT OF NORTHERN RHODESIA R. L. Prain	2/6
TSETSE FLY CONTROL Dr. K. R. S. Morris	2/6
MUSIC (Three Lectures)—IN EDUCATION Dr. Greenhouse Allt; —IN THE THEATRE Leslie Bridgewater; —IN MEDICINE Frank Howes	3/6
VIRUS DISEASES OF PLANTS F. C. Bawden	2/6

PROGRESS IN ELECTRONICS

Impedance measurements on a radial ultrasonic transducer developed for continuous cleaning processes

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Journal of the Royal Society of Arts

NO 4981 FRIDAY 6TH JULY 1956 VOL CIV

AWARD OF THE ALBERT MEDAL FOR 1956

With the approval of His Royal Highness the President, the Council has awarded the Albert Medal for 1956 to Sir Henry Dale, O M, G B E, M.D., F R S, for eminent service to science, particularly physiology.

Sir Henry Dale, who was born in 1875, was director of the Wellcome Physiological Laboratories from 1904 to 1914 and director of the National Institute for Medical Research from 1928 to 1942. From that year until 1946 he was Director of the Royal Institution Laboratories and Fullerian Professor of Chemistry. He is still Chairman of the Wellcome Trust.

Sir Henry shared the Nobel Prize for Medicine in 1936 and was President of the Royal Society from 1940 to 1945. He holds many honorary degrees from British and foreign universities, and is an honorary or foreign member of many scientific societies abroad.

The following appreciation of Sir Henry's scientific work has been provided by Sir John Simonsen, D.Sc., F.R.I.C., F.R.S.:

> The achievement of Sir Henry Hallett Dale, O.M., like that of some other great men, has had an element of paradox. By inclination and training a physiologist—and to-day just acclaimed as the *doyen* of British physiologists—he was early diverted by circumstances into pharmacology, and his outstanding discoveries in that field have enriched fundamental physiological knowledge as well as contributing materially to practical medicine and therapeutics. A brilliant lecturer and teacher, he has never held a University Chair, yet through his inspiring Directorship of the National Institute for Medical Research fr m 1928 to 1942, and his exceptionally lucid publications, he has pupils and followers all over the world. And it is surely the most remarkable paradox of all that from his examination of the constituents of a crude ergot extract, undertaken a little reluctantly at the request of his employer in 1904, should have stemmed, among other important studies, his researches on histamine and anaphylaxis, and those on the relating of acetylcholine to the transmission of nerve impulses for which he shared the Nobel Prize in Medicine in 1936, as well as, indirectly, his work on posterior pituitary extract and on biological standardization. He himself has attributed some of his discoveries to good fortune; but it is the kind of good fortune with which genius only is favoured.

BICENTENARY MEDAL FOR 1956

The Council have awarded the Bicentenary Medal for 1956 to Dr. W. J. Worboys, Chairman of the Council of Industrial Design, for his outstanding services to the promotion of industrial design, particularly the establishment of the Design Centre for British Industries.

Dr. Worboys has been Director of Imperial Chemical Industries, Ltd., since 1948, having held various posts in the company since 1925. He has been a member of the Council of Industrial Design since 1947 and its Chairman since 1953. He is Vice-President and immediate past Chairman of the Association of British Chemical Manufacturers and a member of Council for the Society of Chemical Industry.

It will be remembered that the Bicentenary Medal was instituted in 1954 as a permanent commemoration of the Society's Bicentenary and is awarded annually 'to the person who in a manner other than as an industrial designer has exerted exceptional influence in promoting art and design in British industry'.

ROYAL DESIGNERS FOR INDUSTRY

On the recommendation of the joint committee of the Society and the Faculty of Royal Designers for Industry, the Council has appointed Mr Reynolds Stone, C.B.E., to the distinction of 'Royal Designer for Industry' (R.D.I.) in recognition of his work for lettering.

Mr. Stone, who teaches lettering at the Royal College of Art, worked at one time in a country printing office but eventually became a professional engraver in wood and stone. In addition to his eminence as a letterer he is distinguished in the field of book decoration and illustration, and his work, in the best traditions of typography and type-design and of calligraphy, has a quality that has rendered it eminently suitable for application to industry and commerce. He has designed many trade labels, trade marks, badges and letter headings, and in 1946 designed the 3*d*. Victory Stamp, while recently he designed the new official Royal Arms used by the Stationery Office for Government printing. He also designed the Minerva type-face for Linotype & Machines, Ltd.

IMPERIAL INSTITUTE

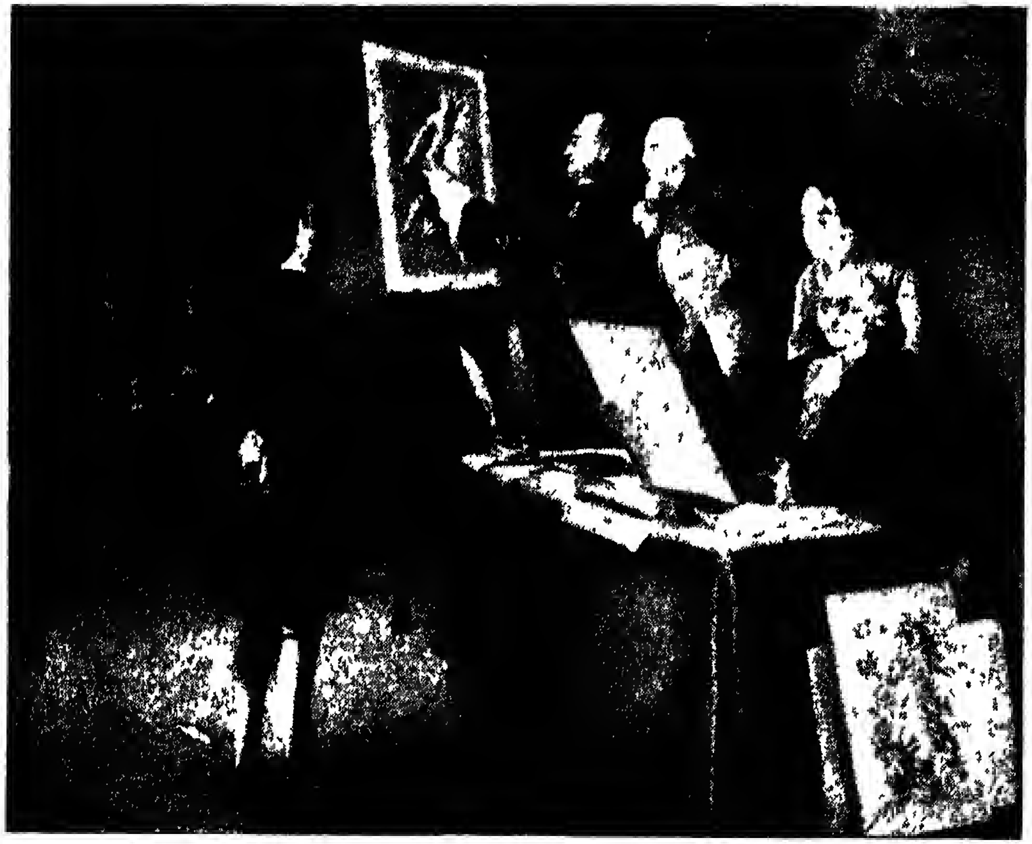
Fellows will remember that, as was announced in the *Journal* for 13th April, 1956, the Council at their April meeting passed a resolution expressing their concern at the proposal for the complete demolition of the Imperial Institute building and urging that further consideration should be given to the possibility of adapting at least the tower and *façade* to the uses of the enlarged Imperial College. This resolution was contained in a letter addressed by the Secretary to the interested authorities.

On Thursday, 21st June, Mr. Henry Brooke, Financial Secretary to the Treasury, stated in a Parliamentary written answer that by a decision of the planning authority, the London County Council, the sites in Princes Gardens, previously restricted to residential development, were now to be made available also for certain other uses, thus reducing the density of building in the central area of the site.

Mr. Brooke then continued as follows:

> The college have also considered with great care, in consultation with the L.C.C. and the Royal Fine Art Commission, whether in the light of this ruling it would be possible to meet the commission's wishes on the Collcutt building. The conclusion is that it is still not possible to meet their wishes in full without reducing the scale of the expansion at the Imperial College on which the Government have decided, and to which they attach great importance; but a revised plan has been prepared which not only gives a lower density of development but would also enable the central tower of the Collcutt building to be preserved by the college as a free-standing campanile. Before a definite decision can be taken it will be necessary for expert advice to be obtained on the stability of the tower as a separate unit.

THE SOCIETY'S CHRISTMAS CARD



The subject of the Royal Society of Arts Christmas Card for 1956 has been chosen from the records of Benjamin Franklin's association with the Society in view of the 200th anniversary, on 1st September, 1956, of his election to membership, and of the 250th anniversary of his birth, which was celebrated on 11th January, 1956.

In the picture reproduced above, Miss Anna Zinkeisen, R.O.I., R.D.I., has reconstructed a meeting, held on 3rd February, 1759, of the committee responsible for the conduct of the Society's fine art competitions. At this meeting, selected candidates were interviewed for confirmation of their awards.

The Minutes of the meeting give a list of those who were present, and from contemporary portraits Miss Zinkeisen has been able to select those shown. They are as follows:

Judges: Benjamin Franklin (seated); Mr. (afterwards Sir) William Chambers (standing behind chair); Edward Hooper and James 'Athenian' Stuart (looking at figure drawing by Richard Cosway).

Candidates: William Peters (being examined by Benjamin Franklin), Richard Cosway and Henry Pingo (seated at end of room).

The flower design (by Pingo) shown beside the table and Cosway's figure drawing were both entered for the 1759 competition and are still preserved by the Society.

A Christmas Card order form is included in this issue of the *Journal.*

BEAUTY IN DANGER—THE RURAL SCENE

A paper by

SIR GEORGE PEPLER, C.B.,

Past-President, Town Planning Institute, read to the Society on Wednesday, 25th April, 1956, with Dame Evelyn Sharp, D.B.E., Permanent Secretary, Ministry of Housing and Local Government, in the Chair

THE CHAIRMAN: Before I ask Sir George Pepler to read his paper on 'Beauty in Danger—The Rural Scene', I should like, if I may, to read to you a message which my Minister, Mr. Duncan Sandys, has sent to the Royal Society of Arts on the occasion of arranging these talks. As you may or may not know this whole question of preserving beauty both in town and countryside is something in which my present Minister is enormously interested. I have seen many Ministers who have taken some more, some less, interest in this particular subject; and I can certainly say with confidence that nobody has taken a more thorough, more persistent, and more determined interest in the whole subject of beauty in town and country, and the preservation of beauty in both town and country, than the present Minister of Housing and Local Government. This is his message:

> Since the days of King Arthur, 'beauty in danger' has always been an inspiring and stimulating topic. Your Society are to be congratulated on initiating these lectures and on choosing Sir George Pepler and Sir Hugh Casson to speak upon the two principal aspects of this problem.
>
> In the years between the wars, large tracts of our countryside were invaded by the towns or disfigured by unsightly intrusions. Much of this was quite unnecessary, and it went largely unnoticed and uncriticised except by a few vigilant citizens. Happily, public opinion to-day is much more awake to the need to resist further desecration of rural beauty and, where it is still possible, to repair the ravages of past thoughtlessness.
>
> Through the Planning Acts, the Government and the local authorities now have far-reaching responsibilities for guarding not only the natural beauties of Britain, but also the appearance and character of her towns.
>
> In the urban areas, planning powers are in practice more difficult to administer—partly because architectural tastes differ and partly because any change in the existing pattern usually entails heavy expense. We can readily unite to defend the natural charm of hills and woodlands. It is not so easy to reach a common judgment upon man-made things, such as blocks of flats, public buildings, lamp-posts, advertisements, and so forth.
>
> Nevertheless, whatever differences there may be, I think we are all agreed that as a nation we are still far too indifferent to standards of building and planning, and that public interest must be stimulated and developed in both the positive and the negative sense. For it is the public who ultimately set the tone; and we must look to them to demand quality in new construction and to insist upon the removal of eyesores and indiscriminate clutter.

I welcome the inauguration of these lectures; and I wish success to the Royal Society of Arts in the timely lead they are giving. I am sure they will have the solid backing of all who love our country and wish to preserve and enhance the beauty of our towns and countryside.

There is nothing for me to add to that and I will now ask Sir George to read us his paper. I understand that he will be very willing to answer any questions that anybody may like to make after he has read it, or both he and I will be very happy to hear comments, criticisms, suggestions, or anything anybody would like to contribute on this subject of beauty in danger.

The following paper was then read:

THE PAPER

I understand that the decision of the Royal Society of Arts to provide a forum for a discussion on 'Beauty in Danger' was to a considerable extent influenced by 'Outrage', a special number of the *Architectural Review* published last year.

My friend Sir Hugh Casson is to give the second paper and I may inadvertently cover some of the same ground, or even contradict him on some points. Should the former happen I apologize to you; but should there be contradiction I offer no apology to Sir Hugh, since he is entirely capable of looking after himself. In any event I am sure that he and I are at one in condemning any outrage on beauty either in town or country.

Since I have been nominated by the Council for the Preservation of Rural England to give this paper, my remarks will be mainly concerned with rural England. I must, however, absolve that Council from any responsibility for any views I may express, although I have been a member of it since its inception and a member of its Executive Committee from the moment my official duties ceased. It is possible that the Council may regard me as a heretic in at least one respect. For example, when my friend the late Lord Justice Scott went for a drive in the country and saw one bungalow, he was inclined to exclaim that the whole countryside was being disfigured by bungalows. While, should there be roses growing over the porch and cheerful children playing in the garden, my response was more likely to be 'how jolly'.

Please forgive me for opening this talk with a welter of 'I's'. My personal position in the matter is of no importance, but I am anxious to make it clear that the C.P.R.E. is not committed by anything I say.

It is important to bear in mind that the C.P.R.E. has never been merely preservationist. Under the inspiring leadership of Sir Patrick Abercrombie, who has been its Chairman from its foundation, it has never urged that rural England should be treated as a 'museum piece'. On the contrary, it has always recognized that change is inevitable and will normally be beneficial, if carried out in the right manner. I think it is fair to say that the main planks in its platform have been the conservation and development of our agricultural resources and the improvement of the social environment of the rural population. Such a policy is necessary for our own preservation as a nation, but apart from that it is perhaps worth reminding ourselves that it is the beauty of our countryside which attracts visitors, many of them dollar-spending, from all parts of the world. In the words

of Mr. S. L. G. Beaufoy, at the National Conference of the C.P.R.E., at Norwich, last year: 'Our countryside, unique in all the countries of the world, does not just happen; it is not just a gift of Nature, but the product of man's devoted labour over the centuries, and is dependent on the continuance of that labour'.

We must all agree that 'Outrage' has performed a very useful service in stirring us all up and particularly in reminding us 'that we are all offenders as well as victims'. This reminds me of A. P. Herbert's series of articles in *Punch*, many years ago. They concerned the doings of a young lady who was I believe called 'Topsy'. One of her adventures was to be driven in a car through a lovely countryside, to which her friend the driver paid not the slightest attention; but when they arrived at Peacehaven, the sight of which was too much for Topsy, he exclaimed 'Petrol at last'. On the other hand, 'Outrage' states that 'public authorities are responsible for nearly all of the faults exposed in this issue', and that most of them have been approved by a planning department.

John Betjeman, in *The Spectator*, described 'Outrage' as

> the most damning illustrated indictment of concrete lamp standards, 'Keep Left' signs, municipal rockeries, chain-link fences, truncated trees, garish shop fronts, pretentious hoardings, wires, poles, pylons and ill-sited power stations, that has yet been published.

So much for the illustrations, but in the text the warning is sounded that we are at present making an ideal of suburbia and are in danger of reducing England to universal 'Subtopia'. Before considering the validity of these accusations, indictment and warning, it would I suggest be appropriate briefly to review the powers that Parliament has progressively given to deal with these matters, and how those powers have been and are being exercized.

The first Act to confer town planning powers upon Local Authorities was the Housing, Town Planning Etc. Act, 1909, and although it limited the power to prepare Town Planning Schemes to 'land in course of development or likely to be used for building purposes', it was I believe, the first public Act that referred to 'amenity' as a factor to be taken into account. Moreover (Section 59 (2)) excluded from compensation

> any provisions inserted in a town planning scheme, which with a view to securing the amenity of the area included in the scheme or any part thereof, prescribe the space about buildings or limit the number of buildings to be erected, or prescribe the height or character of buildings and which the Local Government Board, having regard to the nature and situation of the land affected by the provisions, consider reasonable for the purpose.

It is worth noting that 'character' was interpreted to cover both the use and external appearance of buildings, and that the third Scheme to be passed, namely that of the Ruislip-Northwood U.D.C., empowered the Council to require reasonable alterations to be made in regard to the design or materials of any proposed building, if in the opinion of the Council

> the character of the building or buildings proposed to be erected or altered would be injurious to the amenity of the neighbourhood, whether on account of the design or the undue repetition of the design or of the materials to be used.

Also, under the wing of amenity. the Ruislip–Northwood Scheme, *inter alia*, prohibited the display of advertisements (with some exceptions) in the area of the Scheme, 'in such a position or manner as to interfere with the amenity of the area or any part thereof', and restricted factories and shops, and so on, to particular areas shown on the map, in order to keep residential areas free from the possible noise, smoke or smell of factories, and from the alleged unneighbourliness of shops.

The Housing, Town Planning, Etc. Act, 1919, put planning under the newly formed Ministry of Health and, *inter alia*, partially rectified the narrow scope of the 1909 Act by enabling local authorities to form joint committees for the preparation of a scheme.

Considerable use was made of this new power in the inter-war years and some admirable regional schemes were prepared, notably by Sir Patrick Abercrombie, and published, but most of them were advisory only, although a number of executive joint committees were later formed in order to carry them out. Eventually all these joint committees were axed by the 1947 Act.

Minor amendments of the 1919 Act followed, including the Housing, Etc. Act, 1923, which extended planning powers to areas of æsthetic or historic interest, whether developed or not; but in 1932 all previous legislation was supplanted by the Town and Country Planning Act, 1932, which remained the principal statute until 1943. The C.P.R.E., which had not long been formed, can claim considerable credit for educating informed public opinion to demand this Act, although the Council was not satisfied with all its provisions; for example, the only mention of agriculture was (Section 12 (3)) to exclude agricultural buildings from planning control.

Nevertheless, the Act made clear that it applied to 'Country' no less than to 'Town', and authorized the making of schemes for almost any land, urban or rural. It confirmed the limited part playable by county councils in town and country planning, which had been conferred on them by the Local Government Act, 1929. It gave limited powers to restrict building sprawl by limiting building operations to areas where public services (such as roads, water supply and sewers) were either available or could be provided without excessive expenditure of public money, or where the operations would be likely seriously to injure the amenity of the area. It enabled orders to be made for the preservation of buildings of special architectural or historic interest, and the Model Clauses made under the Act, by the Ministry, provided, *inter alia*, for the preservation of trees, the tidy upkeep of private gardens, and the control of advertisements.

The influence of the C.P.R.E. is evident in Section 1 of the Act, where the objects of planning schemes were widened by the addition of

> preserving existing buildings or other objects of architectural, historic or artistic interest and places of natural interest or beauty, and generally of protecting existing amenities whether in urban or rural portions of the areas.

The 1932 Act had not got fully into its stride before the outbreak of the Second World War, but although few planning schemes had been approved by the Minister, many were in an advanced stage of preparation. With reference to

the preservation of the amenities of the countryside, it is worth while to draw attention to a number of schemes which were prepared by the North Riding County Council (acting for the District Councils by agreement) and were approved just before the outbreak of war. These schemes were remarkable for two reasons: (*a*) they set up joint boards to carry them out; (*b*) they preserved the bulk of the county, much of which comprises beautiful landscape, now incorporated in the North Yorkshire Moors National Park, from building development by means of zoning, that is, without incurring compensation. The three zones designed to achieve this result were: (1) 'Rural', in which only dwelling houses for agricultural workers, buildings required for agriculture, buildings (of limited size) required for rural industry, and buildings required in connection with the winning of minerals, were allowed free entry; (2) 'Landscape', in which no building of any kind could be erected without permission; (3) 'Moorlands', in which the only buildings to have free entry were those required for the purposes of the rearing, preservation and shooting of game.

(N.B. These three zones were based on Circular 1750 *Rural and Coastal Zones*, issued by the Ministry of Health, in 1938, following the publication of a *Report on the Preservation of the Countryside*, by the Minister's Town and Country Planning Advisory Committee, of which Miss Evelyn Sharp, as she then was, was the Secretary.)

Under the 1932 Act, the exercise of planning powers by local authorities was optional and, by 1942, 73 per cent of the land of England and 36 per cent of the land in Wales had become subject to 'interim development control', although only five per cent of England and one per cent of Wales was subject to operative schemes.

The Town and Country Planning (Interim Development) Act, 1943, deemed all land to be subject to planning, gave some sanction to interim development control and enabled the Minister to require any interim application to be referred to him for decision.

The Minister of Town and Country Act, 1943, is of primary importance, because it provided for the appointment of a Minister of Town and Country Planning

> charged with the duty of securing consistency and continuity in the framing and execution of a national policy with respect to the use and development of land throughout England and Wales.

This duty has since been inherited by the Minister of Housing and Local Government, and the Secretary of State for Scotland is charged with a similar duty for that part of the United Kingdom.

The Town and Country Planning Act, 1944, was mainly designed to deal with the reconstruction of war damaged or obsolete portions of towns and for the first time enabled local planning authorities to buy land simply and expeditiously for planning purposes.

The New Towns Act, 1946, and the National Parks and Access to the Countryside Act, 1949, are of major importance in relation to specific objectives

of town and country planning, and the Town and Country Planning Acts of 1953 and 1954 deal with the problems of land ownership, but planning control in general now operates under the Town and Country Planning Act, 1947. This Act of 1947 superseded all previous planning legislation, other than the New Towns Act, 1946.

Before considering the principal changes introduced by this Act, other than in relation to compensation and betterment which are the only provisions which have given rise to serious controversy, we shall I suggest do well to remind ourselves that it is administered by a Minister 'charged with the duty of securing consistency and continuity in the framing and execution of a national policy with respect to the use and development of land throughout England and Wales'. Clearly, the preservation and creation of amenity must form an important part of such a policy, but by no means the whole.

In relation to the subject we are discussing, I suggest the following as the major changes in the planning machine effected by the 1947 Act:

(*a*) The requirement that survey should precede planning. Prior to the 1947 Act many local authorities and joint planning committees had carried out excellent surveys (a number of the latter and one or two of the former having been prepared by Sir Patrick Abercrombie), but these were done voluntarily.

The Reports of Surveys that have been prepared as a result of the requirement that each development plan should be accompanied by such a report, have, in my opinion, fully justified the requirement. They are for the most part thoroughly done and admirably presented, and not only enable one to understand the purpose of the plan, but also, in total, represent what may be termed a new and better Domesday Book. The further requirement that a fresh survey should be prepared every five years, in fact ensures that such surveys will be constantly under review and kept up to date, and that is all to the good.

The fact that the Ministry has prescribed a general form of survey and supplies information from national sources ensured co-ordination of effort, and the 26 national maps already prepared by the Ministry's Technical Department, to a scale of ten miles to the inch, and published by the Ordinance Survey Department, provide a national background of great importance.

(*b*) The substitution of the Development Plan for the Town Planning Scheme, with the requirement that it shall be reviewed at least every five years.

(*c*) The transference of the duty to prepare plans from the councils of the non-county boroughs, urban and rural districts to the county councils, thereby reducing the number of Local Planning Authorities in England and Wales from 1,441 to 146.

(*d*) Of less importance to planning in general, but cogent in relation to our subject, it may be noted that the Act enlarged the control over advertisements, broadly re-enacted the provisions for the preservation of trees and woodlands and for securing the preservation of buildings of special architectural or

historic interest, plus requiring the Minister to compile lists of such buildings. It also empowered the Minister to make grants towards any compensation for which a local authority might become liable in its exercise of such powers.

While the councils of county boroughs and counties are the only local authorities empowered to prepare development plans, they are empowered, by agreement, to delegate powers of administration to the councils of county districts, which councils also come very much into the picture when it comes to implementing the plan by the purchase of land and the carrying out of public works. Delegation may include power to approve or disapprove applications for development within the area of a district council where local influences may not unnaturally predominate. Therefore just as the Ministry has powers of control to be exercised in relation to national policy, it seems desirable that the County Council should retain sufficient control in order to safeguard county policy. Moreover, in both the preparation and administration of plans it is obvious that there should be close liaison between the county councils and county boroughs.

Although, in general, no development (that is, the carrying out of building, engineering, mining or other operations in, on, over or under land, or the making of any material change in the use of any buildings or other land) can now be carried out without planning permission, this does not apply to Crown Lands, which includes land belonging to government departments. Moreover, the Act empowers the Minister to make orders giving general permission for specified classes of development.

Such an Order (S.I. 1950 No. 728) was made by Mr. Hugh Dalton, and called by him 'an experiment in freedom'. By it permission was given (except in particular areas which a local planning authority might specify, with the Minister's approval) for the following forms of development, many of the manifestations of which are pilloried in 'Outrage':

The erection, construction or placing, and the maintenance, improvement or other alteration, within the curtilage of a dwelling house, of any building or enclosure (other than a dwelling, garage, stable, loosebox or coach-house) required for a purpose incidental to the enjoyment of the dwellinghouse as such, including the keeping of poultry, bees, pet animals, birds or other livestock for the domestic needs or personal enjoyment of the occupants of the dwellinghouse. Provided that the height shall not exceed, in the case of a building with a ridged roof, 12 feet, or in any other case, ten feet.

The erection or construction of gates, fences, walls or other means of enclosure not exceeding four feet in height where abutting on a road used by vehicular traffic or seven feet in height in any other case, and the maintenance, improvement or other alteration of any gates, fences, walls or other means of enclosure.

The painting of the exterior of any buildings or work otherwise than for purposes of advertisement, announcement or direction.

The erection or construction and the maintenance, improvement or other alteration by a local authority of:

(i) such small ancillary buildings, works and equipment as are required on

land belonging to, or maintained by them, for the purpose of any functions exercised by them, on that land otherwise than as statutory undertakers;

(ii) lamp standards, information kiosks, passenger shelters, public shelters and seats, telephone boxes, fire alarms, public drinking fountains, horse-troughs, refuse bins or baskets, barriers for the control of persons waiting to enter public vehicles, and such similar structures or works as may be required in connection with the operation of any public service administered by them.

The installation in an electric line of feeder pillars, or transforming or switching kiosks or chambers not exceeding (except when constructed underground elsewhere than under a road) 1,000 cubic feet in capacity; the installation of service lines to individual consumers from an electric line.

If we turn from some visible objects to consider the general land-use pattern that is emerging from the Development Plans that have already been prepared for the greater part of England and Wales, we find that it is one which provides for the rounding-off of existing towns, the expansion of some small towns, with the rest of the country not designated for any particular form of development other than new or improved roads, but subject to general planning control, although some proposed green belts may be indicated and also areas of great landscape value to which particular controls apply. Sites for no more new towns are at the moment designated, but boundaries of most of the proposed National Parks have been settled, although the National Parks Commission may be expected to designate more areas of outstanding national beauty, towards the cost of caring for which Exchequer grants are available.

In Circular No. 42/55 of 3rd August, 1955, to local planning authorities and county district councils, the Minister drew attention to 'the importance of checking the unrestricted sprawl of the built-up areas, and of safeguarding the surrounding countryside against further encroachment', adding that he was 'satisfied that the only way to achieve this object is by the formal designation of clearly defined green belts around the areas concerned'. Also, in answer to a question put to him in the House of Commons, on 21st February this year the Minister replied, 'I have approved applications for building in the London green belt on only about 45 acres, and have refused applications involving over 2,000 acres in the past year'.

So far, I have given a very sketchy outline of the powers that exist to control the matters we are discussing and by whom and how they are administered. Before going on to discuss whether or not existing powers suffice or require tightening up or extension, it is, I think, worth while to note some of the sources (other than Ministerial) of advice at present available to local planning authorities:

(*a*) The Royal Fine Art Commission is ready to advise upon important issues of design, and is empowered, if it so desires, to call the attention of any Department of State, or of the appropriate public or quasi-public bodies, to any project or development which in the opinion of the Commission may appear to affect amenities of a national or public character. The Commission is generous in giving skilled advice, but its powers are purely advisory.

(*b*) The Council of Industrial Design was set up in 1944, with the object of improving 'the design of British products by all practical means other than by control or dictation', and, *inter alia*, has turned its attention to such things as lamp standards which are such notable features of the townscape.

(*c*) The Council for the Preservation of Rural England has, in collaboration with the Royal Institute of British Architects and the Institute of Builders, set up voluntary panels, in many counties, to advise local planning authorities with reference to plans of buildings submitted to them for approval.

In addition, the following list of items included in the Agenda for a recent meeting of the Executive Committee of the C.P.R.E., gives some idea of the scope of the work with which it is continually occupied and on which it makes representations to any department or local planning authority that may be concerned: Services' Land Requirements; Roads and Footpaths; Town and Country Planning; Afforestation and Trees; Mineral Undertakings; Water Undertakings; Inland Waterways; Electricity Undertakings; Nuclear Power Stations; Television Stations; Oil Pollution of the Sea; Advertisement Control; National Parks and Access to the Countryside.

ARE EXISTING POWERS SUFFICIENT?

In my opinion the general land-use pattern emerging from the Development Plans, which I have described, answers the question in the affirmative, particularly having regard to the strong action the Minister is taking with reference to green belts. We have, of course, to remember that the exercise of the powers is subject to financial considerations which have to be taken into account at both central and local Government levels. These considerations would be greatly lightened were compensation to be abolished; but would this be fair? Or would it be reasonable for us to press the Government and the local authorities to spend more of our money?

A further fundamental point to bear in mind is that in directing and administering planning policy, the Minister must take into consideration rival claims for land-use. Each of us, at one time or another, may have regretted his decision on a particular matter, but he has to consider every point of view—not only ours—from a national standpoint.

I do not for a moment endorse the statements that 'planning machinery is being used to speed Subtopia, not to check it', and that 'any hope of intelligent interpretation was lost when planning was tied down step by step with local government, and made into another unrewarding office job'. On the contrary, it is my privilege to know personally many planning officers of local planning authorities and I have yet to find a body of men more devoted to their work or more intent upon upholding the ideals of town and country planning.

It may be that on many highways in the country, although by no means all, one may see unsightly things, particularly if one is looking out for them, but what one does not see are the overhead wires that have been put underground and ugliness that has been prevented; nor may one realize that some eyesores

are of old standing and that there are some on which the planning officer could not report to his council, because they were outside planning control.

When I venture the opinion that existing powers are adequate to produce and are gradually producing an appropriate general pattern of land-use (and that is the first essential), one does fully realize that visually there is still much to be desired, particularly with reference to such matters as the design of lamp standards and street furniture in general, to which 'Outrage' draws special attention.

Many of such matters could be brought under planning control by a revision of S.I. 1950 No. 728, to which I previously referred, but on this I would venture two comments: the function of the erection is of primary importance; for example, as a motorist I do want adequate signposts, and to know when I am approaching a roundabout and when I am required to turn in a particular direction. Also good street lighting is essential for both pedestrian and motorist. Also, with reference to the design and external appearance of all buildings and erections one enters the field of taste and the remedy here is, I suggest, rather by education than regulation.

To return to the basic pattern of land-use, the conclusion drawn by 'Outrage' is that because Britain is industrial, overcrowded and small,

> all our development must be high-density and small-area. High-density industrial belts, with buffers of true country in between. High-density towns, with their population neither spreading outwards nor decanted evenly, but put back into the centre.

No one can question the fact that England is industrial, overcrowded and small, and personally I think we might give much more thought to migration within the family of the British Commonwealth. I cannot, however, for a moment agree with the suggestion that we cannot save our countryside unless we build at high densities; and since this conclusion drawn by 'Outrage' is not supported by evidence, there is no need for me to argue the point here. On the other hand, it does seem to me unfortunate that so arguable, and to my mind untenable, a conclusion should have been propounded as the only method by which we can secure towns that are towns and country that is country.

WHAT CAN WE ALL DO TO HELP?

Although I have suggested that the available machinery of town and country planning can be made adequate to preserve the rural scene, I do not for a moment suggest that we have any ground for complacency. Far from it.

First of all, we need to see that the best possible use should be made of available powers and this will, I believe, prove more rewarding than proceeding on the assumption that, failing new powers nothing worthwhile can be done. As 'Outrage' so rightly points out, this is a job for all of us and that to fit ourselves for the task we must learn to use our eyes and 'then to know your local area inside out, whether it is a Surrey suburb, the middle of Swansea or the Yorkshire Wolds'. Having used our eyes and got to know our local area inside out, we shall then be in a position to influence ministries and local authorities,

who are manned by people very like ourselves, and members of parliament and local councillors elected by us as our representatives. It will not suffice to confine our influence towards securing full use being made of town and country planning powers. It must extend into the field of education in order that the young and adolescent shall be brought up to understand the places in which they live and to appreciate good design. We can make our influence felt in these matters both individually as voters and collectively through such bodies as the Council for the Preservation of Rural England and local Civic Societies. It is by joining these bodies that we can best help to free the beauty of the rural scene from danger.

DISCUSSION

THE CHAIRMAN: I think we all have good reason to be extremely grateful to Sir George Pepler for that review of powers and responsibilities in relation to planning and for his general conclusion of where we have got to. Nobody is better equipped than he to do a thing like this, and nobody has contributed more to the whole planning movement than Sir George.

The only comment that I think I would like to make from the Ministry is that he has given us an impressive survey of the development of powers in the planning field; and yet at the end of it all, as the article 'Outrage' I think does underline, many of us feel very uneasy and uncomfortable about what, in fact, is happening. I entirely agree with him in not accepting all the conclusions in the 'Outrage' article, especially the implication that we ought to stop any further encroachment of town upon country. I doubt if that is practicable in a country such as ours. But without going that far I am sure that many of us must feel uneasily that there is any amount of unnecessary ugliness being created both in town and country. I really cannot accept that it is almost exclusively perpetrated by Government Departments. It nevertheless must be admitted that the Government has a share of responsibility. My main feeling on the whole subject is that I very much agree with the conclusions which Sir George drew when he was talking about what we can all do to help, that this is a job for all of us, and that to fit ourselves for the task we must learn to use our eyes and to know our local area inside out. It is obvious, I think, that this prevention of ugliness is not going to be achieved by powers of control, no matter who exercises those powers. It is going in the end to be achieved only by an enormously greater public consciousness of what is ugly, and what it is that the public does not want and will not stand for.

I have been greatly impressed myself lately, when going into the country over Easter, to realize how little I have been accustomed to use my eyes. It happened that just before I went down to Cornwall for Easter I had something to do with the whole question of the prevention of litter (do not let it be thought that I have done something to prevent litter because I have not) but I had something to do with the administration of the problem and with the Bill recently introduced by a Private Member on this subject, and with that in my mind, driving down to Cornwall by Salisbury Plain and Exeter, my eyes were fully open to litter, perhaps for the first time in my life. I do not know whether it has always been true, but I realized that there was not one quarter-of-a-mile of that main road in which the hedges were clear of litter, of newspapers, paper of every kind, which can only be thrown out of cars and buses, and for the first time I woke up to the beastliness of such litter. With that consciousness in mind I have been wondering ever since what we can do about it That is only an example. I think that the truth is that we are many of us extraordinarily unconscious of some of the things that are done, the bad, the ugly, the disfiguring things that are done or allowed to be done in the countryside and in the towns; and that if we wake up to it and then create enough opinion and make enough

noise and trouble all round about the things we do not like, we shall begin to have an effect. Among the things about which I personally feel very strongly are some of the lamp-post designs, particularly in villages in rural areas, that have been allowed in recent years. If we can be coherent and vociferous enough about these things, that is the way to achieve progress. I think all the planning powers, and the devoted efforts of local authorities, have done a very great deal in recent years, but they will not do the whole thing. They cannot do the whole thing and certainly not in a country such as ours. In the end only public opinion can do it and that is one of the reasons why I, and my Minister, have so very much welcomed these two talks which the Society has arranged, because this is all part and parcel of the business of stirring up public opinion—as was the 'Outrage' article. Although in many ways I think the 'Outrage' article was outrageous, I think it did an enormous amount of good.

MR. A. C. CHAPPELOW: I live in a house in Downshire Hill, Hampstead, that dates back to about 1823. Although the houses are mostly scheduled as of historic interest, in the matter of garages it appears that if you ask for a licence to put up a temporary garage, you can do pretty well what you like. Anyhow I have got a prefabricated garage next door to me. They wanted to put it half way down the back garden, but I did object to that. It was explained to me by the London County Council and, I think, the Local Council, that as it was to be a temporary garage a permit could not be refused. I have a suspicion the garage will remain there until it falls down and will then be replaced by another 'temporary' garage.

Immediately opposite me is a beautiful little house owned by a very well-known architect; he has put up a garage which has corrugated sheeting as a roof. I think if I had asked for permission to put up that ugly garage in this lovely road, it would have been refused. It seems to me there are knotty problems, especially over garages.

THE CHAIRMAN: I do not, of course, know the facts of the case, but I suspect that this business about a temporary garage, or non-temporary garage, may date back to the days of building licences, which is quite another story. I am not at all sure, as regards planning control, that a garage, a small addition to a house, is not one of the exempted things; although I think that the local planning authority is entitled to consider the external appearance even though they cannot prevent the owner from having a garage of some kind. Generally, however, I think that what you have said does go to the root of what Sir George has said, that all these things are so much a question of taste. You may, indeed, be right in saying that this particular garage is ugly, but somebody, somewhere, perhaps in the local planning authority's office, has not thought so That perhaps reflects the state of public opinion. It is one of the most difficult problems I find, certainly looking at it from the Ministry's point of view, at what point to tell people they cannot do what they want. Sometimes I feel so appalled at the amount of control and form filling and delay involved in the present system of planning control that I would like to say let us abolish planning, let people do what they like, and let public opinion operate; let your neighbours throw stones at you if you do something ugly, but do not let us do it by rule and regulation.

Although this is not a very satisfactory answer to your question, it is the best I can do without knowing the real facts.

MR. CHAPPELOW: The garage could not be plainer or uglier.

MR. W. M. WHITEMAN: I should be glad to hear the speaker on two points. He did mention local influence on planning decisions and I think we would all agree that local opinion ought to receive sympathetic consideration, but it is very human to dislike and object to every new development in our own areas and that does happen on rural councils. On the other hand, I think there are extreme examples of seaside resorts and other places which rather tend to sacrifice amenity in consideration of trade and profit and benefit of the rates and so on.

Sir George was rather guarded on this, but would we be right in thinking that he considers the delegation of powers from the county councils to the more local level has gone a bit too far?

When we have done our best to protect the beauty of the countryside by perfecting the planning control, what do we do with it. Presumably, it is being protected in order that it may be enjoyed by the public, but the trouble is that the public in a mass is just as capable of destroying the countryside as are unsuitable buildings and works. Should we take a democratic view and say it is the heritage of all the people, let us encourage them to go out there, for they will get physical and moral benefit and let us hope we can educate them in time before they do irrevocable damage; or do we take the policy of privilege and say, let us lie quiet about how much beauty there is in the countryside, let us not publicise it and advertise it, but leave it to be enjoyed by those who have learnt about the beauties and are probably a bit more capable than the rest of respecting them?

THE LECTURER: The first point raised by Mr. Whiteman coupled the questions of local interest and delegation. With reference to delegation, the reports to the Central Panels Committee of the C.P.R.E. from the Advisory Panels operating in the counties indicated that in some counties delegation was resulting in too-lax control over the elevations of new buildings. This result might be due to the fact that members of a small local council were so intimate with their neighbours as to make them reluctant to interfere with any action one of them might propose to take.

The second point, namely as to the advisability of keeping quiet about beauty, raised the question of national parks. In this connection, Mr. Geoffrey Clark, the director of planning for Devon, said in effect with reference to a proposal to establish a National Park in his county: 'The proposed area is a beautiful piece of country which we all enjoy and we and the limited number of people from elsewhere who come to share our enjoyment know how to behave. If it were advertised as a national park, we should have it crowded out and that would be to nobody's advantage'. I express no opinion as to whether or not this is democracy. It seems to me to be a question of manners. Should multitudes be let loose on a thing of beauty before they have learnt not to destroy it? A *Code of Country Manners* has been published, but personally, if I know a place of beauty I do not advertise it.

MR. W. H. GIFFARD (of the C.P.R.E., Gloucester): We have been very concerned in Gloucestershire about the development round and in Cheltenham. Cheltenham Borough has delegated powers and the Borough Engineer has the final word, and has put up a bus station. No architect was called in; he designed it and everybody says it is dreadful. But outside of Cheltenham Borough, in the rural district of Cheltenham, there is development consisting of rows and rows of similar red brick bungalows of very bad design. We have discussed it with the Planning Officer and he says there is nothing that can be done as the designs have been passed. We can appeal, but if he appeals to the Minister he probably will not be backed.

THE CHAIRMAN: Why does he say that?

MR. GIFFARD: We had a conference with our Council Architects just over a year ago and we sent forward four resolutions. One of those resolutions asked the Minister whether better and fuller backing could be given to the Planning Officer. The design of the bungalows is, by general consent, frightful, but they are still going up. All the same, as an illustration about what the lecturer said about taste and education, I was passing that estate some time ago, in a van moving some of my furniture, and I said to the driver, 'Aren't those dreadful?' He said, 'No, that is exactly the place I should like to live in'. So I am at variance with public taste. Yet we have a Planning Officer who does not like it, but says he cannot do anything. So what can one do?

THE LECTURER: I should have thought that the Planning Officer should be encouraged to go ahead, because Gloucestershire has a very good record. I know your C.P.R.E. Branch and I should have said, taking the Cotswold part, perhaps that is not quite Cheltenham, that in the Cotswolds as a whole, although you could not now expect to get your stone roofs and so on, you have kept colour and size extremely well. I am therefore surprised that the Planning Officer should have said that he could do nothing about it. You did mention, however, that the persons who own the bungalows like them very much and I remember well—this is many years ago—a case on the Broads, where the local planning authority wanted to stop a whole lot of riverside bungalows going up. There were some there already, and unfortunately the chairman of the committee was the owner of the fleet of pleasure boats that traversed the Broads. Somebody knew about this and he was asked if the people who took his trips had ever been asked what they liked most to see on the Broads; he said 'yes, they say: those jolly little bungalows and gardens on the rivers'. It does come back to this question of taste, but I must say in Gloucestershire I should have thought you had a very strong case, certainly in the Cotswolds, and that you had largely achieved it. I am always quoting the Cotswolds, except when you had got your architects, this is many years ago, to design a charming little stone house as a model and the plans were sold for 10*s*. 6*d*. each. It was a beautiful plan, but unfortunately a speculator bought a copy and then erected repeats of the design all along a skyline where they looked like a set of false teeth.

MR. A. L. ROBERTS: The Hampshire County Planning Authority is, and has been for many years, advised on matters relating to architectural design by a system of Area Panels, each responsible for a particular section of the county. These panels are guided on policy by a County Panel formed with the Chairmen of the Area Panels, plus the County Architect, and the County Planning Officer. It is as Chairman of this County Panel that I now speak about a difficulty which has presented itself to my Panel, and comes from one of its Area Panels, which has the right to ask for guidance in giving their advice on problems of considerable importance and interest to our rural scene.

The personnel of these panels is recommended by the Local Architectural Association, then approved by the President of the Royal Institute of British Architects, after which the members are appointed by the County Council. The system was set up in accordance with the wishes of the Central Panels Committee, appointed by the R.I.B.A. and C.P.R.E., to deal generally with the establishment of panels and to help local authorities on their behalf.

Recently the Area Panel responsible for that part of Hampshire adjacent to the County Borough of Portsmouth referred to our County Panel a problem which has been recurring at intervals for some considerable time and which they felt should be brought to the attention of higher authority. It is a matter of principle and concerns development carried out by the Admiralty, particularly in the field of housing. The protest made by the Area Panel is that the standard of architectural design of schemes submitted by the Admiralty is not up to the standard to be expected from a Government Department carrying out development on such a large scale. In some cases negotiations have resulted in improvement but, as always in negotiations, a compromise is inevitable and rarely entirely satisfactory. The Area Panel concerned expressed the view, which is fully endorsed by my County Panel, that Government Departments should set an example in good design. It is particularly important in our South-East area, where the local authorities concerned for housing produce work of a much higher standard of design than do the Admiralty. We know that the Minister of Housing and Local Government and our Hampshire County Council also are doing all in their power to sponsor good design with the help of qualified staff, and the latter body with the additional voluntary assistance given by the architects on their

panels, and it does not seem fair that an important Government Department like the Admiralty should not have come under the same statutory regulations, with regard to obtaining planning permission, as private developments. The fact that Admiralty schemes are submitted more as a matter of moral obligation rather than necessity makes the work of the Planning Authority much more difficult than it otherwise might be.

In the circumstances I have explained, I wish to enquire whether there is any special way in which our Planning Authority can approach the Minister of Housing and Local Government with any hope of getting this difficult problem solved satisfactorily in the interest of our rural scene in Hampshire. As Sir George has said, the Minister has to consider every point of view and we realize that this problem is a difficult one to solve.

THE CHAIRMAN: I think that is a good example. I, of course, know nothing about the pros and cons of the particular case, but I would not bring this trouble to the Minister of Housing and Local Government if I were you, I would bring it to a high level in the Admiralty. Why don't you, if this is true? Why don't you have a row? If there is something really wrong and you cannot get anyone to pay attention to your protest it is no good going on negotiating in a gentlemanly way. Why not send to the First Lord of the Admiralty photographs of those houses, if they are really bad houses, together with photographs of better houses that local authorities have built? Tell him that the Admiralty are getting a bad name in the area—if that is true—because their houses are conspicuously unattractive. Really write to the Admiralty the kind of letter that could convince them that there is very strong feeling in the locality. Tell them that you are quite happy to arbitrate on it. Tell them that they can send down any independent architect they like and if this fellow really says 'as a matter of fact you are wrong, they are quite good houses', then all right. But you ought not to lie down under this sort of thing. If you have a real complaint make it felt. Bring public opinion to bear. But do not do it, of course, unless you are sure that the complaint is well founded. I believe that that method of going about things may be more effective—especially in this difficult field of taste—than the orthodox method of asking my Department to intervene.

PROFESSOR L. DUDLEY STAMP, C.B.E. (A Member of Council of the Society): Madame Chairman, you have just given us an invitation to have a row and I think myself that in a way the discussion this afternoon has gone off on a wrong line. We have had a remarkable exposition from Sir George Pepler of the evolution of town and country planning and I would go so far as to say that the good things we have got, the measure of the control, the bad things which are not happening, are in a very large measure due to what Sir George did in his official position when he was with the Government. We have past and present with us this afternoon and I venture to think that many of the good things which are happening to-day are due to the active interest of our chairman.

What has really happened the last few years is the transference of power from the individual to local and central government. Whereas in the past we had individual outrages in the way of bungalows we now get collective outrages perpetrated by local authorities. But do let us remember the other side: that we have developments that I suggest are good. I would quote the agricultural workers' cottages which we started during the war. They were of good design and raised the standard in the country to a level not previously enjoyed. A good basic design was adapted to meet local needs for the lasting benefit of tenants.

On the other hand, I agree very much indeed with what has been said about certain Government Departments being the worst offenders of all. We will not draw distinctions, but certain Service Ministries do seem to be outside any approach whether from æsthetic, economic, national or any other grounds and there is much to be done there. But apart from the Service Ministries, who are the guilty parties for the

from the reports that the Borough Council were seeking some kind of advice, but I would rather doubt that the advice they are getting originates with a body such as the Institute of Landscape Architects. I think in this matter, because the Embankment is not only Chelsea's particular asset, but is part of London's river front, some effort should be made to see that the best advice is given. I can quite understand that the plane trees have outgrown a convenient size, but before anything is done I feel that the matter should be dealt with either at a high level or through the medium of some competent landscape advice. If Professor Stamp, also a confessed resident in Chelsea as I am myself, would join with me in writing a letter to the Borough Council about this matter I should be delighted.

I suggest his help about this because after the war for some time, even though the Festival of Britain was on, the stone flower troughs which formed part of the War Memorial in Sloane Square had not been replaced and I wrote to the Town Clerk, as to-day people have advised, although it does not always lead to good results, and asked if he would call the Borough Council's attention to the fact that the better part of the War Memorial has not been put back, although a second war had taken place, and would they rectify the matter. Nothing happened for some time. I then wrote again and learned that the matter had come up before the appropriate committee; I was perfectly right in thinking that the stone troughs should be back, but they must confess that they removed these to preserve them from war damage. Somehow or other, in a mysterious way, there had been a loss or theft, so that the flower troughs could not be put back; but the Council were going to make some move in the matter. The result was that the most appalling makeshift flower containers arrived after about a year at the expense of people like myself and Professor Stamp. In them were planted some three-quarter dead veronica bushes which never came to any good.

Subsequently, mercifully, a fountain, long overdue, was established in Sloane Square, the work of a very eminent sculptor. It caused a lot of excitement and a good deal of criticism, but I personally am very glad to see it there, and no longer press for the return of the War Memorial stone troughs. But you see what a job it really is when as a lay person and a subscribing member to the rates—through which medium one hopes to get a few amenities—makes an effort to get a satisfactory result. Unless one can do it through some sort of energetic group, like the Chelsea Society, which does everything it can with that in view, as we still have these devastating threats one feature after another tends to be swept away.

A vote of thanks to the Lecturer was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

BEAUTY IN DANGER—THE URBAN SCENE

A paper by

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read to the Society on Wednesday, 2nd May, 1956, with the Right Honble. The Earl of Euston, M.A., F.S.A., Deputy Chairman, Society for the Protection of Ancient Buildings, and Member, Historic Buildings Council for England, in the Chair

THE CHAIRMAN: I am sure that Sir Hugh Casson needs no introduction from me. I do feel that the whole subject of 'Beauty in Danger' is of particularly vital importance at the moment. I am sure that is obvious. Anybody, even the most unobservant, must notice what is happening in the country to-day. I also feel that time is getting short during which anything can be done. These atrocities are becoming daily more obvious to everybody, and action surely must be taken now.

I think it is a matter of great satisfaction that the Royal Society of Arts should have inaugurated these meetings to draw attention to the danger and to what is happening in the country. We are extremely fortunate to have Sir Hugh Casson with us to-day. Nobody has done more than he to focus attention on the problem, and unlike many people he is not content merely with deploring it and wringing his hands; he has constructive suggestions to offer, and I will not take up any more of his time. I am sure that, like me, you will all want to hear what he has to say.

The following paper was then read:

THE PAPER

The subject of this paper is, whatever the title may be, Ugliness. I know that we have all got a lot of other things to worry about besides ugliness, and to many people it may seem ridiculous to worry about what is frankly a surface picture and not the basic causes of such a surface picture, but I believe that ugliness has ceased to be a symptom and has become a power so evil, so active in this country, that it really does almost threaten to become a danger to our society. Do let us remember that ugliness is not the result of evil intention—for nobody makes things ugly deliberately—but it is always the result of ignorance. It is to-day, I submit, an outrage no longer to be endured, and I feel that the planning profession and all members of communities and societies interested in our surroundings should be united to destroy it. Now there are obviously going to be a whole lot of opinions as to how this can be achieved, but I hope that some of the suggestions which I shall put forward, and may be put forward in the discussion later, may be of some help.

About a year ago a special number of the *Architectural Review* came out under

the title of 'Outrage'. Some of you may have seen it. The front showed a picture of the approach to a normal English town. It could be anywhere—Yorkshire, Lancashire or Kent. The title was taken from Sir George Stapleton's phrase 'that in this Island to misuse a yard of land is an outrage upon posterity', and the object of that publication was not to draw public attention but to drag it by the scruff of its neck to this mildew of mess and muddle which, even in the past few days that have gone by since the last paper on this subject in this hall, have probably destroyed another few acres of the bits we have left.

Now if success is to be judged by publicity and newspaper cuttings, the results of this issue were absolutely astounding. Almost every newspaper in the land welcomed it with a leader. Radio and television gave and are still giving it a lot of attention. I have started recently for the British Broadcasting Corporation a series of six journeys into Subtopia, and to those of you who do not know what Subtopia is I can only say that it is nowhere in particular because it is everywhere. It is in fact where we live, and all this 'silver-jewel-set-in-a-silver-sea-green-and-pleasant-land' that you read about on grocers' advertisements and in travel books is rapidly becoming a myth, and will become more of a myth unless we do something about it.

Now everybody at that time a year ago seemed to agree that Subtopia was intolerable and that something ought to be done to stop it, and people began to ask questions. 'Why is it, despite the jungle of legislation which seems on paper to restrict the smallest human activity in the most annoying way, that these things still go on happening? What are planning authorities up to, and who is to blame for all this mess and muddle?' Has planning failed, or'—this is a more serious point I think—'is Subtopia not only inevitable but actively preferred, or at least not resented?' Those were the sort of questions that were asked at the time, but as indignation, especially on a national scale, is always short-lived, the heat of public anger cooled. Other crises loom up and last week's scandal passes like a thunderstorm and you hear it muttering and flickering about on the horizon. It may or may not blow up again. Meanwhile there is plenty else to worry about, and if there is not, the newspapers will create it to-morrow. Those of us, however, who are more closely concerned, that is the architects, planners, sociologists, engineers, geographers, the administrators and the workers on local authorities, all of those who really care, cannot take such an irresponsible view. We can breathe a sigh of relief that the limelight has left us, but we have all been very shaken up, and there is nothing more discouraging than a blow to one's self esteem.

Those of you who have read 'Outrage' or who have read some of the articles upon it may say that the whole thing was a hysterical journalistic stunt, that the photographs were faked, that the emphasis was unfairly slanted, that it did not deal with fundamental causes, and things are really not quite as bad as they have been stated. Some may even say that there are still plenty of beautiful towns and acres and acres of lovely countryside, so what is all the fuss about? Others may dismiss the 'Outrage' issue as useless because it was unconstructive. Now this last point is perfectly true. This publication was deliberately unconstructive. It did not try, except in a very few pages, to say anything about what could be

done about the problem. What it did do was to say 'LOOK'! Now this was deliberate because we did want, quite frankly, to make the public's flesh creep and to make its eyes widen in dismay. You have got to use those kind of shock tactics. Most of this country, visually speaking, is composed of the walking dead. You have only got to walk down the street or sit in the tube to see that. Now sleep walkers can be coaxed back to safety, gently, but occasionally they have got to be yanked by the elbow and pulled back, and we felt that in this case a 'yank' was needed to avoid disaster. 'Look North', says Mr. Nairn who wrote this, 'Look South, you see everywhere the services or excreta of Subtopia. Rot in the centres, dump and sprawl at the edges, nibble, litter and spread in between. If you drive from here to Penzance, you drive through a scum of paper and bus tickets from end to end.' 'Planning is everywhere on the defensive, usually on the retreat. Planning has become a dirty word. No politician would dream of using it. To the man-in-the-street, it means something that stops him from doing something that he wants to do. It is a nuisance or else it is just a joke'.

That, I admit, is a slight exaggeration of the situation. But I think even the most optimistic of us feel that the post-war idealism, which we all had, has begun to seep away in the nagging struggle against expediency, delays,

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FIGURE 1. *Rot in the centre; Oxford*

false tolerance, weak-mindedness and timidity. What are we going to do about it ? We are either going to admit defeat and quit, which in my view means visual disaster (to which you might say, 'Who cares'?) but I believe it would also mean spiritual disaster to which you cannot say 'Who cares?' I think the time has come to counter attack upon a national scale with all the vigour at our command, and to do that we have got to know the ground and define our aims and recognize our enemies and friends.

First, do let us clear our minds of hypocrisy and stop allotting the blame to others. It is very usual, particularly as far as our towns are concerned, to lay the blame on the industrial revolution of the Victorians, but folly and Philistinism are not the prerogative of any age, and I have yet to have it proved to me that if the Georgians, or the Athenians of the Golden Age, had been faced with a steam engine and canals and the textile mill, they would have made a better job of them. We certainly have not done much better ourselves. Steam left its grime and squalor, electricity and the petrol engine have brought their own and, in my view, even more pervasive ugliness, and I have no doubt that nuclear fission and automation will bring a new kind equally discouraging. Nor is it any good to make a scapegoat of the old Aunt Sallys, the chain stores, the hoarding magnates, the service departments and the electricity undertakings; they are all guilty people I quite agree, but many other people are guilty all the time. We are all in this together, and it is no good wasting time calling each other names, there is far too much to do. The enemy in this case is not other people but Ugliness, and Ugliness means disorder, and disorder means inefficiency, and that is what the country, I am sure you will all agree, cannot afford.

So let us admit weakness and failure where they have occurred. Admit that planning has failed to justify to public opinion the inconvenience of its restrictions by the success of its results, either in the creative or protective fields. Bear in mind, too, as I feel we must do in fairness to the planning profession, that we only see its defeats. You may go round the country and say, 'why has planning not stopped this?' What you do not see is all the things that planning *has* stopped. We have, in fact, a great deal to thank the planning profession for in having saved us from what might have been a great deal worse.

Nevertheless, there are planning weaknesses. I am not a planner, and I am speaking very much as an amateur and will probably be shouted down by any expert here. The first thing to note perhaps is that the Ministry of Planning—which is now called Housing and Local Government, because they cannot bear to use the word planning—was originally conceived as a constructive organization to plan research, to evolve a national plan and to be creative. Now it still is to some degree I admit, but it has gradually been reduced to the *rôle* of administering Planning and Housing Acts—in other words it is kept so busy on administration that it has not enough time for doing active creative planning work. I dare say that that is inevitable, but it seems to me that other ministries like the Board of Trade, Ministry of Works, Ministry of Transport and Ministry of Fuel, are the people who so often have the final say.

Secondly, the regional physical planning machinery, which did a great deal of

work after the war in giving technical advice, has been progressively cut and, practically speaking, no longer exists. That means that what one might call abstract matters such as industrial distribution, official research and so on, is thrust upon local planning authorities, some of whom are equipped to deal with it, some of whom are not. Very often you will find that local planning authorities have delegated their powers of creative planning to urban and rural councils. Sometimes you will find that this works well: sometimes you will find that the people who have to do the job are not up to it.

None of the following activities which I shall now list, whose effect upon the look of our landscape is absolutely decisive, are subject to planning control at all other than that of courtesy requests for co-operation and consultation.

Agriculture (including all structures connected with it).

Public Utilities (Railways, Power Stations, Gas Plants, Atomic Energy Establishments).

Service Departments.

Street Furniture (including roadside planting and felling).

Some of those items I think were freed under what was called the 'Experiment in Freedom' introduced by Dr. Dalton, who was Minister at that time some years ago. He said, and I agree that there is a lot of justification for it, that 'you cannot control all these things. You must have a bit of elbow-room and have an experiment in freedom, and trust people to use their common sense and their taste'. My view is that visually speaking that experiment has failed. Whether it is practicable to do something about it now, I do not know. In defence, once again then, of the planning officers and the planning machine, I should like to say that, just as one only sees their defeats, never their victories, so too most of the ghastly things one sees are not subject to planning control at all, and the fact that these things are there is not always the fault of planning.

The third point is that the lack of popular understanding of the purposes of planning has too often been reflected in the membership of typical local planning committees, some of whom are indifferent or even hostile to the conception of planning. That has incidentally made planning, for the large number of people who are physically employed in it, rather a discouraging and defensive occupation. You are always fighting back, and sometimes even fighting people who should be supporting you. People who, in fact, should be your allies and helping you are, quite often, your enemies.

Those then are some of the administrative weaknesses in planning, which I have no doubt you could add to if you wanted to. But what about physical agents? They are very many, and I would list the following, some of which, as I have said before, are free of planning as far as one understands it.

The first is lamp standards. Now these are a familiar and ghastly subject. Lamp standards are controlled on the main roads by the Ministry of Transport, who control the degree of light which must fall at stated intervals on certain sizes of roads. Now the Ministry of Transport may say, quite justifiably, that what these lamp standards look like is nothing to do with them. All they are concerned with is that the road is properly lighted in a standardized way from A to B. Whether

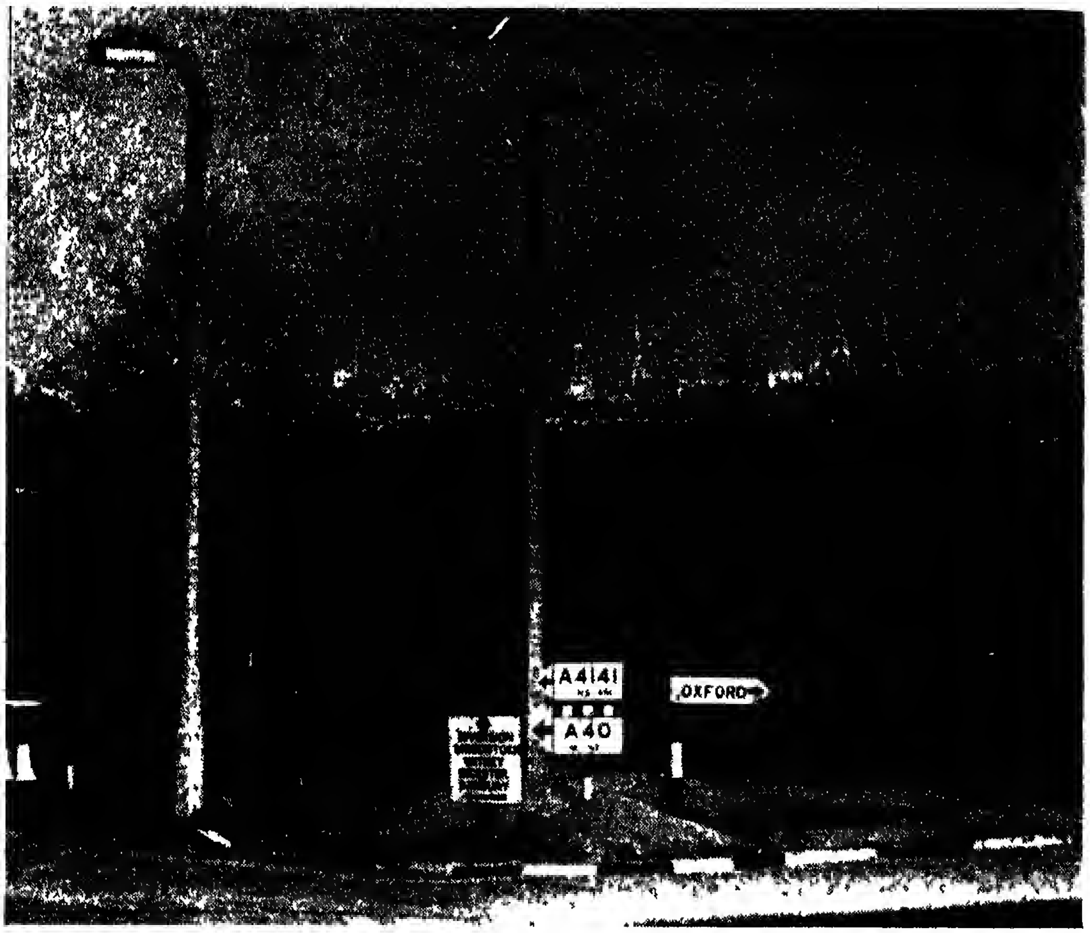

FIGURE 2. *Oxford from the foot of Boar's Hill*

as a result the road is very possibly hideous to drive down is nothing to do with them.

The second agent is 'Dumping Grounds'—by that, I mean those little areas which you find in nearly all streets in London and in any city in this country—sand bins, signs, lavatories, beacons, kiosks, used-car lots, heaps of old iron, and notices. Now there are hundreds of these, and I have great sympathy with the man that has to find a place to put them. But are they all in fact necessary? At Bournemouth the other day, we were discussing this problem. The Borough Engineer told us that he had in Bournemouth recently been removing, under the excuse of maintenance, lorry loads of these objects. Some of the things had been removed for months, and no one had asked for them back!

The third point is the mutilation of trees. Now trees are like children, they are often an awful nuisance. They have got to be cosseted when they are young, they have to be guarded, pruned and controlled. They have got to be swept up after, and at times they have got to be removed, but I am sure that most people will agree that it is worth all that trouble for the result. But to many authorities in this country the sweeping up and its admittedly heavy costs result in trees being cut down in order to save money. No one in fact ever gets to the stage

of asking the residents whether they would really rather have the trees and pay in the rates for that particular cost.

The fourth point concerns suburban sprawl and standard fringes. That has already been discussed and I do not propose to linger on it.

The fifth point is Municipal Rustic. This is a difficult thing to argue about, because taste comes into it. In an attempt to beautify streets you do often find local authorities countenancing or encouraging what one can only call Municipal Rustic, the *bijouterie*, which is inclined to spread round on little islands and at the feet of hoardings, and so on. Now I would not object to this so much, for I always like to see grass and flowers, but when, as it always is, it is done in phoney Cotswold stone and decked out with dainty little railings and fussy planting, then it does become objectionable.

FIGURE 3. *Mutilation of trees*

The next point is wirescape, which I feel is a familiar story to all of you. I was in Woodstock the other day, one of the most famous wirescape victims of the land. It is a very beautiful eighteenth-century town with a little market place, in the middle of which is a complete electrical grid of pylons and cables. The whole place scribbled over as if by a great black pencil. I know you would not do that over a picture or wallpaper in your house, and yet the residents of Woodstock have let it happen over their town; and no marks are due to the last

FIGURE 4. *Woodstock*

Duke of Marlborough for letting it happen, for if you are a Duke, surely the only point of being a Duke is to make a fuss about that sort of thing and not let it happen in, near or around your property. Some of these pylons are at last being removed, so the story may end happily for Woodstock. There are other places, however, not so fortunate.

Now for hoardings. Again this is an old subject. I am told that adequate legislation exists to remove hoardings if you do not want them. It is entirely the question of the energies of the local planning authorities as to whether they have them or not. Personally, I do not mind them in certain places. I feel sure that nobody would feel all that pleased if all the electric signs went from Piccadilly, since the architecture that would be disclosed would not be sufficiently distinguished to make the change worth while. Nevertheless, there are obviously places where you do not want them and where their erection should be resisted.

The most important Subtopian agent of all is the motor car and its apparatus—car parks, signs, traffic lights, noise, and smell. It is the motor car that has done more to destroy our towns and cities than any architect.

Now you may say that architecture is the most important factor of ugliness or beauty in our towns. My view is that it is the least important—not because I am an architect, for if I was loyal to my profession I would say that architecture mattered more than anything else, but I do not believe it, because whatever you do it is instantly deluged with motor-car apparatus and with the demands of the motor car. If you go to ordinary towns the size of Oxford, Hereford, Gloucester, wherever you like to go, I think you will find that really what in fact you look at and what you are aware of all the time is not so much the buildings but the stuff lower down—which is basically always motor-car apparatus.

FIGURE 5. *'Motor-trim' skyline in Kenilworth*

Let us now take a look at our towns. Four out of five people in this country live in towns—most of them, I think, by preference; and by preference, I mean that they have actually taken the decision that their work is going to lie in urban pursuits and that they want to live in an urban area.

I would like to talk now, if I may, entirely about the visual side. I am not going to talk about sewage falls and daylight angles, because in a town you have got to assume that all those things work. I want to talk about towns as works of art, because it is as a work of art that a town is loved and respected, or not, by the people who live there. Now most of the towns, built-up areas as they are now significantly called, that we live in, are beginning to look their age. We have got plenty of good ones left— Winchester, York, Norwich, Bristol, Witney, Ludlow, but even the best of them are mostly beginning to look pretty terrible—inefficient, dirty and inconvenient, and above all shapeless and without character. They have all got the same troubles - no worse, I may say, in this country than they are abroad—depressed housing, congested traffic, lack of open space, uncontrolled spread, and that is why everybody tries to get out of the towns as soon as they can at week-ends. Why are they in this sorry bedraggled state?

In a democracy which is, as you know, a system where you say what you like but do as you are told, action depends upon the public will to act, and in this case it is not there. The man-in-the-street is no longer interested in what the street looks like. The present townsman, remember, is not the townsman he was. He is a sort of hybrid. He does not live in the country or city, he lives in a sort of half-way land. He enjoys sports at second hand. He makes use of the town but without respect or love for it. He invades it daily for work or for entertainment and he withdraws at night to his dormitory. It is this daily assault which eventually beats the place to pieces. It is like a Victorian drawing-room that has been invaded by a gang of very healthy school children. The result is obvious. There is not enough room to move around and things get broken.

The first thing you notice is the destruction of open space. The streets and the squares which were once the scenes of promenade and social gathering are absolutely choked solid, heavy with fumes, overcrowded pavements, disagreeable shopping, public buildings on islands which you cannot reach across the traffic, residential squares invisible behind a huge tin fence of parked metalwork. Architecture, good and bad alike, vanishes beneath advertising and then for good measure thrown over the whole lot is a paralysing slime of bollards, signs and street furniture.

Now I want to do something more than give a crime sheet, for there are a lot of questions which I think we ought to ask ourselves. One of them is, does high density, and by that I mean high and thick buildings, necessarily imply poor living conditions and vice versa? Does the very high density which you find in the desirable and most expensive neighbourhoods of Kensington and Chelsea, which is as high as you will find anywhere, imply poor living conditions? Must services and roads continue to determine the pattern of development instead of being subservient to it as it should? How many public parks are not used as much as they might be because their layout is old-fashioned or unimaginative?

Must high buildings always be more expensive, relatively speaking, than low ones? Does the social success of the neighbourhood concept justify the resulting loss of urbanity in our newer towns, and will suburban life continue much longer to satisfy mid-century man? Is Los Angeles, which is the largest suburb in the world I believe, really the place where in fact everybody wants to live; are we just beating our heads against a wall in thinking otherwise?

I was always brought up to believe that the houses of the poor imitated the houses of the rich. The baronial semi-detached villa in Wembley was a cheaper version of the five-bedroomed Surrey homestead and this was a cheaper version of the mansions of Ascot, which were in architecture and character again a cheaper version of Blenheim or Ditchley. That is the process as it used to be. But nowadays the rich do not quite live that way. They live in tiny little mews flats and little week-end cottages. Will the same process come to the lower income groups? Will they in the end feel that they too want to live in a little hutch in Central London and a little hutch in the country, and the place which is halfway between, say Kingston or Ealing, will that become an anachronism? Those are questions which we have got to face, particularly with the increase of the motor car.

Can we at this stage make any plans for the future at all? Surely we can at least set out our aims and these are: first of all to improve upon the mistakes of the past, secondly to reverse the advance of Subtopia, and thirdly to recreate an environment of which we can all be proud. We have got to have three principles in mind. The first is that we now live in a technological age, and obviously we have not got to resist it. We have got to have pylons and lamp-posts; we all want electricity, and we all want good roads. Secondly, this island is very small; it is industrial and it is overcrowded, and that means that there is no room to mess about. Thirdly, while the responsibility is shared between all of us, it is primarily the responsibility of top management of central and local government to give the lead.

At the moment we have, as we have had in the past, a lively Minister of Planning. We have also determined and enthusiastic industrious people on his staff. But there is not room for complacency because there are weaknesses, and I feel there are ways in which we might be helped by the central government more than we are.

First, in the Ministry of Housing and Local Government itself, I would like to see some department put aside free from the routine business in order to do creative and active work, particularly in propaganda and in designing good examples, guides and bulletins.

The Ministry of Education has a group like this. They have been doing this with schools, and the results have been absolutely first rate. The result is that the schools as now being built in this country since the war are the admiration of the world, and they are largely the result of very stimulating experimental work done by the Ministry of Education and one very experimental and lively local authority—Hertfordshire.

You can do such a lot by good example, much more than by exhortation.

You cannot get good design by legislation, but you can start getting it by good example.

You could choose places in London or elsewhere where everything is of the highest possible quality, and places to which you could take visitors and say, 'This is how it *can* be done'.

I should also like to see the powers of the County Planning Officers strengthened and their work assisted more often than it sometimes is by their Authorities. You find, too, County Planning Committees delegating their powers to the borough, and you find that these smaller authorities are guilty of outrage, both positive and negative, because very often it happens, through frictions between a county and an urban district—often on prestige largely, two or three laymen may, without any qualified advice at all, reject or approve plans. The building owner, I know, can appeal, but he may not be able to stand the expense or delays. You must, in other words, have better qualified professional advice at the lower stages of the planning machine.

A possible aid to good planning, which I think would be a useful help to planning officers, would be the setting up of Design Sub-Committees of each County Planning Committee to act as a sort of visual sieve. Now you would need professional advice, and you would also need what I would call 'informed amateurs', those people in the county who are alert and sensitive in these matters. You would have to pay the professional adviser for, after all, that is his living, but the informed amateur should, I feel, only get his expenses and possibly a subsistence allowance. These committees could be called upon to support the planning officer with the benefit of their informed opinion.

Next I do want to support the suggestion that we have something in the nature of a flying design squad. This has been suggested before (and giggled at)—but it is actually what the Royal Fine Art Commission often is. The Commission sits in London and whenever any local authority or developing body is in any visual trouble they summon the Royal Fine Art Commission to its aid. The Commission is composed of very distinguished and busy men, but they give undying and hard-working service by posting off at a moment's notice to decide upon the size of a lamp-post in Scarborough, or the railing of a bridge in Caernarvonshire. This is admirable but surely wasteful of their talents. It is like using a First XI on a Third XI circuit, and I believe that there should be a very good Second XI of people who might be regionally based and who could be called upon to give help and guidance in the smaller visual problems.

Again, Watch Committees are most important in this fight against ugliness. This is the *rôle* of the crank, the amateur, the devoted and loyal member of the amenity society, and under no circumstances must they feel that their work is being taken over by officials. I would suggest that all existing amenity societies should be encouraged to feel from the Government that they are more needed than ever. Indeed, we want more of them. They should have financial assistance and encouragement. Now the question again is, should there be some new organization similar in aims and enthusiasm to the Council for the Preservation of Rural England, to co-ordinate the work of these Watch Committees in towns

and cities? Should this be a new body or an old one, re-financed and reconstituted, or should it be part of the central Government?

We have now got, under that random collection of suggestions, the whole nation enrolled in this struggle against ugliness. We have the Minister and his enthusiastic expert staff. You have the ordinary citizen and countryman through his Watch Committees and the Local Authority system, you have the cultured amateur through the Regional Fine Art Commissions and the flying squads, and you have the professional coming in at every level.

What are we going to do now? The questions, surely, are these: to ask ourselves, is the existing legislation which we have adequate and powerful enough? If these powers are not adequate, should they be extended, reorganized, strengthened or replaced? In other words, should Dr. Dalton's experiment in freedom be revoked? Is, in fact, the freedom we now have to put these objects anywhere, one which we have shown ourselves able to be trusted with? How do we resolve the fact that those who should be our allies are so often our enemies? So often you find that the battles the amenities societies fight are not against the evil speculative builder, hoarding magnate, or the chain store magnate, they are against the local authority. We are so often fighting ourselves.

A further point is this: as beauty has no financial value, how are we going to put it on to the scales? You cannot say how much value a tree has. You can say that it costs so many pounds to sweep up the leaves, but there is no way of calculating the value of keeping the tree, and because there is no way of calculating that, it goes by default. Are we running the risk of duplication and dilution by setting up any new authority, official or unofficial? It has been suggested that in the end all these things come down to education. It is perfectly true, but education takes a long time, and while it is perfectly true that we are to-day getting better-looking lampstandards and housing estates, we cannot honestly sit back and wait for improvement. We must act *now*.

May I say in conclusion that I have an undying belief in the power of the individual. There is a tendency for us all to say that we are impotent against the powers of those who govern us. This is an excuse for inaction. It is not true. If we do not act as individuals then we are being condemned to what Renan called irremedial mediocrity. I do not know how many of you read a recent issue of *The Times Literary Supplement*, in which the anonymous author warned us of how many steps we have taken along this road: chronic inflation, declining standards of law and order, declining standards of the value of money and social obligation. The hope of the individual in the future of the State declines, the birthrate falls: quietism towards the course of events becomes more and more widespread. Successive Governments lurch from one expedient to another. America, Russia, China, India and West Africa have all got different political systems, but all are what he called dynamic. Britain, France and Scandinavia in his view are static. We stand put and we stay put, comforting ourselves as we always do in the increasing lag of our material standards by claiming that material growth does not matter so long as moral stature grows, and we deceive ourselves in the belief that we alone possess this moral stature.

Whether we do or not is a matter of opinion, but we cannot live upon our claims to it. Sooner or later we must make a value judgment upon the sort of life and society we wish to have in this country. Politically and economically we have yet to face this vital question. Upon visual matters, in the fight against ugliness, the issues are much more clear and the way ahead easier to perceive. It is difficult to believe that with resolution and enthusiasm we cannot succeed. It can be done if only it can be made known that it needs to be done.

DISCUSSION

MISS EVANGELINE HOOPER: I should like to make a plea to the people who have so much to do with planning. Some years ago I had to revise a local directory, and I walked many miles round a new estate. It did strike me that there was very little consideration given to the women who have to push prams or walk along with a small child from one part of the estate to another.

The charm of the City of London is that it has so many little alleyways that you have endless short cuts. Their origin I know goes back to mediæval times.

It does seem to me that, in planning new estates, whereas the gentlemen go round in their cars with their foot on the accelerator for a couple of hundred yards, it is a very different proposition for a woman who has to carry a heavy shopping basket. Anybody connected with planning these new estates would do a real kindness in trying to allot just a passageway, wide enough to allow a pram to get through, at the corners of some of the roads, because so often they try to design the residential street so that it is away from the main road. The side roads are generally designed in an arc, so that if a person wishes to go to the other side of the arc, a very long journey is necessary, when just a yard or two taken off somebody's back garden might be able to provide the facilities for a passage.

THE LECTURER: I sometimes feel that the whole battle of Subtopia should really be led by women! All the achievements, all the best sort of crusades have been led by women, from Florence Nightingale onward, and most of the best work for amenity in this country, I think, has been done by organizations like the Women's Institutes and the W.V.S.

As to this particular point, we all know that the layout of housing estates nearly always, and particularly where it is done by road engineers, is dominated by the motor car. The motor car, it seems, must have precedence over everybody else Therefore you get pavement curves smoothed off more than they need be, because the car driver who is sitting in comfort, warm, and listening to his radio, must not be allowed to have more than five seconds delay, while you and I, who are tramping on the pavement, have got to go all the way round the corner in order to cross safely. I do hope that if anybody has a suggestion like that made by the last speaker, he or she will go to his local authority and put it to them. Local authorities are usually willing, if not anxious, to listen to complaints.

LIEUT.-COL. CART DE LAFONTAINE, O.B.E., T.D.: About 25 years ago a builder friend of mine had an estate which he was about to develop. It was a large estate, and he proposed to divide it into half, getting an architect to design houses on one half while he and his office would do the houses on the other. It was agreed that they should be reasonably good houses costing about £2,000, with a third of an acre each. I saw him about three years later and asked him how the scheme was going. He replied that he had sold all his houses, but he had not sold any of the architect-designed ones yet! I asked him how he accounted for that. His answer was that the estate was not exactly suburbia but very nearly so, and the psychology was wrong. 'When we get a new resident here, the first thing the wife does is to call on Mrs. So and So,

who is the leader of the local community, and then she comes to me and says, "I do not want to see any plans, I want a house just like Mrs. So and So's". The result is that the family moves into a house identical to one down the road, even to the curtains in the windows'.

A good many years ago there was a man who had a garage on a lovely Yorkshire moor. It had every eyesore imaginable—enormous signs on steel piers, overhanging tin roofs, and so on. One of my acquaintances suggested that he invite a friend of his, a Royal Academician who was an architect, to look at it. The garage proprietor agreed. The R.A.'s comment was 'What a horror, it ought to be blown up. It is the worst thing I have seen for years and once seen, never forgotten'. My friend rubbed his hands, and told the garage owner exactly what the architect had said. The proprietor said that was just what he had expected and that he would now be able to put in the advertisements and signs, 'Once seen, never forgotten'.

About 25 years ago, when I was on the Council of the Royal Institute of British Architects, I put forward a proposal that in schools one period in every week should be devoted to planning. The children would have a simple set of plans and drawings, and an appreciation by some local architect from the local panel of the Council for the Preservation of Rural England, who could spare, say, half an hour a week. On Saturdays they might go out and look at one of the buildings, study it and compare it with their notes. This proposal was taken up by the Council. The Ministry also thought it a good idea, then we came up against a snag. The teachers refused. They said that if you had voluntary education in a school, bang went the Burnham Scale. There are more difficulties than some people realize.

I do agree that the basis of the whole problem is the education of the public. It does not matter how long it takes, because you will always get what the majority of people want—it does not matter what rules you make. As long as people like horrors, they will have them.

MR. LOUIS OSMAN: I feel that the time has come when there should be a change of emphasis. The emphasis for the past years has been on preserving old beauty, and a wonderful job of work has been done by the amenity societies, which has resulted in legislation for the purpose of stopping people destroying beauty; but there should now be a change towards encouraging new creative work. We have surely gone as far as possible in the way of devising legislation, and what we should do now is not so much to condemn outrage, as to see that new work is done well and to praise it when it is. Beauty grows old and can be replaced by new.

There seem to be so many opportunities missed. We look backwards towards the beauties of historic architecture, but we forget, to take only one example, that in the last few years we have had a most wonderful new medium presented to us in the form of electric lighting. This could be used with creative imagination to give new and exciting beauty in our countryside, but instead it is creating horrors. I think that authorities should encourage the attitude of trying to devise means of creating new contemporary beauty in everything that is done, rather than of taking an interest in stopping people doing things.

Various speakers have asked, 'who is to blame'? I am certain that the answer is 'the client'. There are plenty of good designers but the modern client, so often a committee, does not know his job and how to get the best from the designer. He is a bad client and gets the bad work and the ugliness he deserves. In the eighteenth century the client was educated; considered it his responsibility to have taste; was interested and had the finance to back his judgment. He went to considerable trouble to know the right person for the right job. I do not think that our Government departments and our local authorities nowadays spend half enough time and trouble in finding who is the right person to go to, nor do they often commission work in a way that permits the creation of new beauty. Further, although plans are submitted for

everything, a great majority of people who sit on committees cannot read a plan. I feel strongly that it would be a great service to the community, and to the people with the responsibility of commissioning work in particular, were there training in the reading of plans in our schools. A member of the City Corporation recently asked me to give him some advice on Sir William Holford's plan for the precinct of St. Paul's because he could not read the plans at all, and had no comprehension of what was intended; and yet he would have to vote on it and to say whether it was a good or bad plan.

One of the great destroyers of beauty—noise (low flying aircraft for example), has not been mentioned.

BRIGADIER J. L. P. MACNAIR: Sir Hugh, I think, has a doubt about some of the 'free' departments that were allowed by Dr. Dalton, and he mentioned Service Departments as one of them.

I feel that in many cases these departments who can act on their own have dealt very much better with the country than some of the ones who cannot. Take for instance the Post Office; all the new work that is done by it is, on the whole, pretty good. The Service Departments cannot be blamed too much. I do not know how they set about it, but they have a pretty individualistic outlook. The new Duke of York's Headquarters at Chelsea, for example, makes one realize that they have not done badly themselves.

On the other hand, I do not altogether follow Sir Hugh on the matter of schools. I know that I am in the minority here because our schools are approved by people who come from Sweden and other places, and whose styles we are inclined to imitate. The Ministry of Education no doubt has a call on the best advice it can get, but I am not at all happy about it myself. I see these enormous glass erections, great biscuit boxes, nearly all windows, through which the children spend all their time looking instead of paying attention to their work. There is a very good example at a place where I very often go in Wales, where there is a question of building a new secondary school. There was a most beautiful large nineteenth-century country house in a park, which to all the local residents appeared the ideal place for a secondary school. It had surroundings with a certain amount of tradition and had architectural value. The schools people came along and said that it was no good. It is perfectly easy to find good arguments why a place is no good—the roof leaked, the rooms were not convenient, they could not fit it in, it would be expensive to convert. Sir Hugh knows as I do that no architect likes to take an old building and refashion it inside to make it do the job. They like to produce an absolutely new and brilliant plan, which this local council did. They have spent several hundred thousand pounds putting up a new secondary school, whereas this building, which could have been used perfectly well for the purpose and provided some tradition for the children who went there, has now been pulled down and sold to contractors.

Sir Hugh said that he wanted to bring in the man-in-the-street, but unfortunately the man-in-the-street is not interested, and therefore he has to be educated. However you educate him, I think it is statistically provable that he never will be interested The chap who is interested is somebody with a particular form of mentality which has grown up with him through tradition, through inheritance and lots of other things, but which is quite different from the attitude of the man-in-the-street. The man-in-the-street is the man who gets on the committees, of which I personally am absolutely terrified. I think you never get anything really successful and original, thrusting and forward out of them. In my own view we shall not get anywhere until we can get back to the old idea of the Manor.

Many years ago I asked a fairly senior person in the Ministry of Town and Country Planning, as it then was, why could the Manor not be revived, bearing in mind the acres of despondency that you see in places like Dagenham. Millions of people live

in what I would call health and uniformity, but with very little outlook to increase their appreciation of beauty. I was told then that the idea of the Manor was going to find its way into modern planning. Well, where is it? It never does appear in the latest plans. As far as I can see what we want is a centre of culture which is not a village club. It should be based on the individual.

MISS ELIZABETH DENBY: I hope that you will forgive me if I say that both this week and last, when Sir George Pepler spoke, I felt that the power and the sensitivity of ordinary men and women in Britain were underestimated, and the benevolence and good taste of government departments over-estimated.

I feel in short that the chief sinners are not uneducated people in the ordinary sense of the word, but the educated. Take First Division Civil Servants for instance, who are responsible for open-cast coal mining, sometimes done against great local opposition. Open-cast mining has destroyed many beauty spots. I would like to see Development Plans made after discussion with the citizens concerned. At present people are merely *informed* that such and such an alteration will be made in their countryside, in the near future or over the next twenty years. Ordinary people are deeply disturbed when local beauty is threatened. Occasionally this disturbance is heard, as when *The Times* reported a squabble about a village duck-pond recently. The local people wanted it cleaned while the Council wanted it filled in for a car park. I am glad to say that the local people won. You have probably found, as I have, that a local paper (I take the *South London Press*) is much more passionate in protecting local beauty and tradition than are many of the planning proposals for that area.

I would like to suggest to Sir Hugh that, instead of setting up another Government department to look after us, we should be allowed to prevent our gardens being chopped off for the widening of a road, we should be allowed to protect the beauty of our own countryside unless unanswerable reasons are given for change. The problem in Britain is to turn industrial towns into beautiful towns, and to make country towns and villages even more beautiful. We want less government control and more local initiative—not the other way round.

DR. JOHN POWELL-EVANS: I wish to speak about lamp-posts. As one goes about in hot tin boxes, at least the lamp-posts do usually illuminate the road, which is more than can be said of the even more ugly things that were there before. But is it beyond the wit of the architect to design a standard that will fulfil the requirements and force it through the public bodies? They are obviously made by the same manufacturer throughout the country—they seem to be exactly the same design. It does not seem to me to be impossible to force an improved design on the maker rather than the users. It would not cost very much more. I know there has been an enormous amount of correspondence on the subject, but at least that is an aspect of the problem that could be tried.

MR. T. F. THOMSON: May I say that as far as the public are concerned we have in Hampshire the most satisfactory system of control, assisted I may add by all the professional advice it is possible to obtain. I would, however, be the last to say that this technically efficient system is necessarily producing the results that it should. There is a missing link.

I was interested to hear Sir Hugh Casson mention that he thought that the Royal Fine Art Commission should be regionalized. I made the same suggestion to Sir Patrick Abercrombie at an address of his some years ago. He said he thought it was a good idea and took it up, I believe, in high quarters. It does seem to me that that is one of the first things that ought to be done, because where there is a matter of considerable national æsthetic interest, the local interest can sometimes override the national interest. Matters of æsthetic importance should be subject to review at a relatively high level and it should be done by a body of people who could

be recruited, I am sure, on an inter-county basis, consisting of the same sort of people who produced the best of our development centuries ago, assisted by some of the best architects of our time. This body could, in each case, give a considered opinion on anything that was referred to them. That void is at the moment not filled; and I feel that something ought to be done in the way of forming regional sub-committees of the Royal Fine Art Commission to act in *liaison* with the local planning authorities.

MR. L. J. GRIFFIN: I do not own a car myself, so I see quite a bit of the street. Sometimes I ride in a car, but I cannot say to the driver 'Look at that terrible thing over there', because we may wreck our car. The driver of a car does not see the town at all, so he does not worry; he is only concerned with the traffic in front of him.

Most of the inner properties of a town are owned by big commercial companies. Could not one of our modern 'Florence Nightingales' go round and teach all these commercial concerns. In that way we might tidy up a little bit here and there, and stimulate interest; perhaps firms could inform one another.

MR. A. R. KERRELL-VAUGHAN: I should like to make a point about outdoor advertising such as was referred to in 'Outrage', in particular these gargantuan hoardings we see. I have in mind one bearing nothing but a boxing glove and words to the effect that a certain brand of petrol packs a punch. That is absolutely useless, a relic of the times when advertising was intended for people who could not read. To-day it is an anachronism.

Would Sir Hugh support the idea that the Government, or perhaps some influential body, might convene a disarmament conference between the 'big powers' that inflict upon us these hideous outdoor advertisements?

WING-COMMANDER T. R. CAVE-BROWNE-CAVE, C.B.E.: One of those things that makes a beautiful design better appreciated, and therefore more likely to be accepted, is that the public should, at the design stage, have a better understanding of what it will look like when completed. Sir Hugh Casson knows well how models can be made which are visually correct. The average man cannot visualize the appearance of a design from plans. I feel that if the making of visually correct models were very much extended in connection with new developments, a great many more people could accurately appreciate what was proposed, what the design would look like, and they could also have the opportunity of choosing intelligently between two or more alternative solutions. Visually correct models can be made at a minute fraction of the total cost of the project. They would be a very powerful way of getting popular opinion to appreciate the proposals accurately. I entirely agree that it is popular opinion that you want to influence.

THE CHAIRMAN: I am sure that you will all want me, on your behalf, to thank Sir Hugh for his most excellent address, for his most fascinating and telling *résumé* of the whole problem. The only danger was that it was painted with such a light touch that it almost made one forget what serious words he was in fact using.

I would if I may like to make a personal plea. I feel that this is such a serious problem, this whole business of planning going awry, that it has surely become a national one, and although I think these papers that have been sponsored by the Royal Society of Arts are excellent, they do not seem to me to touch the root of the problem, because we are after all preaching to the converted. All of you really feel as the speakers do, and I should have thought that it was high time to direct public attention to this problem, for instance, perhaps by calling a national conference to survey the whole problem. Perhaps the Royal Society of Arts might consider sponsoring the conference, to try to explore these various very interesting suggestions put forward by Sir Hugh for improving the present position about planning. It seems to me, as an amateur, that one of the main troubles is that the Ministry of Housing and Local Government, which we must not call planning, has not got enough

power. If it is involved in a collision with another Ministry, the Ministry of Housing and Local Government nearly always loses. It seems to me that that must be wrong. Equally the Fine Art Commission surely ought to be given more powers. If, as in the case of the Imperial Institute, their considered opinion is deliberately set aside by the Government, who have after all instituted them, I cannot see that they are fulfilling the function that this should.

Perhaps the Royal Society of Arts might consider this as a proposition. Of course, the agenda and the speakers would have to be very carefully worked out.

Otherwise I would reiterate our most grateful thanks to you, Sir Hugh, for a most stimulating afternoon.

A vote of thanks to the Lecturer was carried with acclamation.

MR. A. R. N. ROBERTS (Chairman, Special Activities Committee): If I may say so, on behalf of the lecturer and of the audience, we are also much indebted to the occupant of the chair this afternoon.

Some of us know the splendid history of the Society for the Protection of Ancient Buildings, whose Deputy Chairman Lord Euston is. Its prime mover, if I remember rightly, was William Morris, who crystallized what has been said this afternoon by referring affectionately to this country as 'this little land', and this is what we must always bear in mind. England is simply not big enough to be able to sustain the injuries which Sir Hugh has so graphically described.

It would be quite wrong for me to attempt, especially in the presence of Sir Ernest Goodale, who is a much older servant of the Society than I, to commit the Royal Society of Arts to the course of action which you, Sir, have suggested. However, I myself have the honour of being the Chairman of what is called the Special Activities Committee, which does advise the Society on useful action which it may take in public affairs, and I shall be most grateful if you, Sir, and Sir Hugh, would spare the time to wait upon that Committee, if I may employ the eighteenth-century phrase, so that we may further consider taking action on lines which you have suggested.

To the Society which you represent, and to you for your conduct of the chair and the contribution you have made to our discussion, I would like to tender, on behalf of us all, our sincere and grateful thanks.

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

GENERAL NOTES

SOME LONDON EXHIBITIONS

On 25th October Pablo Picasso will be 75. For just over fifty years, except for the period of the last war, he has worked continuously in the graphic arts, producing over a thousand original prints and book illustrations. In these he reveals himself far more directly than in his canvases, and it may well be that his extraordinarily nimble and inventive plates remain the best introduction to the successive phases of the master's painting, on which his graphic art throws so much light.

A heady, and, in truth, almost overwhelming collection of over 330 prints and 27 books, representing Picasso's every phase and including nearly all the examples which are generally regarded as his masterpieces, has now been assembled by the Arts Council at 4 St. James's Square. Every day students have been poring over these etchings and lithographs, impeccably catalogued and selected by Mr. Philip James, and arranged in every available room of the house. But it is not a purely specialist exhibition; to the layman, in fact, curious to know just why Picasso has dominated

the world of art for so long, the collection is indispensable. As Mr. James truly says, 'Picasso's fertility of invention is only equalled by his virtuosity, by his lightning perception and his dizzy speed of execution'. Ever since his association with the earliest Cubist experiments half a century ago, Picasso seems, indeed, to have been always ahead of his nearest rivals of the School of Paris, setting one fashion after another. Etruscan and Chinese art, prehistoric and negro sculpture, classical mythology and how much else, has he not assimilated, revitalized, and attuned to the moods of our restless day.

Perhaps the true secret of his hold over us is his power to play on several emotions at once. He can reconcile, as no other artist ever has before, classical gravity and impudence, or again—as in his decorative lithograph of Paloma cuddling her doll—the most tender feeling with a seemingly heartless and perverse stylization. In his variations on the theme of *L'Atelier du Sculpteur*, begun in March, 1933, and sustained for a whole year, Picasso allows his etching needle a freedom to skate over the slippery surface of the metal plate, and create illusions of volume and spatial recession through pure outline, that is quite astonishing. Now capricious, now moved by Guernica to etch an image as grotesquely appalling as his weeping woman, now presenting the masks of mischief or classical serenity, Picasso remains the supreme print-maker of our day, and among the greatest of all time.

It is his eminent associate of the past, Henri Matisse, who is now attracting visitors to the six-foot high bronze reliefs affixed to a wall of the sculpture hall at the Tate Gallery. Known as *Nu de Dos*, this series of four versions of the back of a female nude, executed at intervals between 1910 and 1930, has been offered by the artist's widow to the Gallery for £11,000, of which it is hoped a quarter of that sum may be contributed by the public. The total outlay, Sir John Rothenstein assures me, is appreciably less than the world market price, which the Matisse family might reasonably expect to realize for other sets, limited to 11 cast in bronze; and since the Tate possesses only a small reclining nude in bronze and four paintings by Matisse, there is a strong case for a more adequate representation. The Press photographs that have appeared have hardly indicated the fullness of these beautifully patinated bronzes, which progress from a simple, realistic first state to a degree of simplification that is almost abstract in the disposition of the volumes, reminiscent of the rude pillars of a nave.

The work of Paul Klee has undergone a remarkable revaluation in recent years, and especially since the war. The Tate Gallery's exhibition of his paintings, drawings, and etchings, held at the National Gallery in 1945, five years after the artist's death, is to date the largest and most representative collection by the Swiss-born genius to have been seen in London. Since then, smaller groups of his works have been exhibited at the Tate; but the show of nearly sixty paintings and drawings now at the Hanover is, I think, the first to be seen in a commercial London gallery for many years, and doubtless these idiosyncratic creations will be in brisk demand.

The complexity of Paul Klee's didactic, philosophical, and at the same time whimsical nature has been the subject of many earnest articles and books, some of them sufficiently pedantic to keep the enquiring layman at arm's length. If Klee now seems so much more intelligible, and indeed endearing, than he ever did in his lifetime, that is no doubt because his seemingly child-like imagery has been popularized by humorous illustrators on both sides of the Atlantic, notably by Saul Steinberg and Mr. Punch's doodlers. Look, at the Hanover Gallery, at Klee's wistful manikin, at the mischief of his tadpole creature personifying a tummy-ache, or the padlock taking a stroll at night, and you find the original source of all his imitators. No one else has ever explored so beguilingly the border between mockery and pathos.

NEVILE WALLIS

THE DYNAMIC FRAME

A film *première* is usually a most exciting occasion, with film stars and producers much in evidence. Such an occasion which was held on Tuesday, 12th June, at the Plaza Cinema, Lower Regent Street, differed from the majority in that it was *not* a fashion parade and the film stars were in everyday dress. There were directors and producers and technicians galore.

The occasion was unique: the first demonstration in this country of the 'dynamic frame technique', originated in the United States by Glenn H. Alvey, Jr. Representatives of the Press and the film industry were present to take note.

Mr. James Quinn, Director of the British Film Institute, introduced Mr. Anthony Asquith to the guests and he outlined the general plan of this innovation. The film, *The Door in the Wall*, had been produced in ten days for Associated British Pathé and the British Film Institute's Experimental Committee on Production, and embodied Vista-Vision and Technicolor.

The chief advantage of the big screen is that the film director has a large canvas on which to work, and some spectacular scenic effects have been achieved. But the continuous use of the large expanse has brought its own drawbacks. No single shape or size is suitable for every shot and there has resulted a loss in intimacy. A close-up leaves a lot of screen unused and the outside parts often detract from the main scene. A medium shot with players at full length is difficult to compose.

The dynamic frame has been designed to overcome the major drawback of the wide screen. In this new technique the setting, action and mood of each scene determine its space requirements. The horizontal and vertical format can be imperceptibly varied or even suddenly altered. A wide open landscape uses the whole screen but the claustrophobia of a narrow street is conveyed by tall framing. While the story unfolds so also does the frame on the screen expand or contract to hide or reveal or emphasize a particular incident. The frame is incorporated in the emulsion of the print and a simple flexible solution is available, compatible with all systems now in use. In addition there are new dramatic effects.

The film is based on the story by H. G. Wells in which a Cabinet Minister is offered a new post. He accepts and celebrates over dinner. He then reluctantly declines for some personal reasons which later he has to divulge. As a young boy he found an enchanting garden through a door in a wall. A fairy story came true and he played with other children. Later at school his secret of the garden was dragged out of him but he failed to find the garden again. This garden haunts him and he feels that he will see it again, for its appearance always happens at a crisis in his life.

After the celebration dinner he leaves to go home; next day he is found dead in a garden through a door in the wall. Stephen Murray and Ian Hunter play the important parts of the Ministers.

This film is intended to reveal the potentialities of the new technique and give an assessment of its use in general production as a valuable advance in dramatic exposition. The size of the picture has been limited only by comfortable viewing on one hand and the maximum screen area on the other. The shape of the picture is continuously related to the subject matter and the position of the picture on the screen is governed by the mood and action of the scene. As an experiment in film technique it is revolutionary and well worth seeing.

F. W. M. HEDDLE

BRITISH MEMORIAL FUND FELLOWSHIPS

Four Fellowships, each worth £1,000 (Australian) are offered by the British Memorial Fund. The Fellowships, one of which is offered in Natural History, one in Chemical Engineering, and two for any course of study or research selected by the applicant, are tenable in Victoria, Australia. Each Fellowship, open to United Kingdom residents of British stock and under 35 years of age, is for a period

of ten months. Full details are obtainable from Colonel the Honble. W. W. Leggatt, Agent-General for Victoria and Chairman of the British Memorial Fund, London Selection Committee, Victoria House, Strand, London, W.C.2. The closing date for the receipt of applications is 15th September, 1956.

OBITUARY

MR. T. J. WATSON

We record with regret the death, in New York, on 19th June, of Mr. Thomas J. Watson.

Thomas James Watson, LL.D., D.Sc., was born at Campbell, New York, in 1874, and educated at Addison Academy and the Elmira School of Commerce. After two years as a salesman he joined the National Cash Register Co., of which he later became sales manager. While holding that appointment he was chosen, in 1914, to assume the direction of the Computing-Tabulating-Recording Co. This company later became the International Business Machines Corporation, of whose board, and of that of I.B.M. World Trade Corporation, Mr. Watson was chairman until his death.

A humanitarian who was at the same time a vigorous pioneer of office automation, Watson guided his company brilliantly, on the concept that 'the corner stone is the man himself, whatever his job'. He believed in 'world peace through world trade', and in 1937 was elected President of the International Chamber of Commerce. He received many honours and awards for his service to humanity and international relations, holding over thirty honorary degrees from universities and colleges in the United States and abroad.

In 1947 he was awarded the Medal of Merit by President Truman for his services to the Government during the Second World War. He was for over fifty years a member of the Masonic Order and in 1954 received the Distinguished Achievement award of the Grand Lodge of the State of New York.

MR. J. H. EDWARDS

We also record with regret the death, in Gloucestershire, on 22nd June, of Mr. J. H. Edwards, at the age of 83.

James Herbert Edwards, M.I.E.E., was born at Pencoed, Glamorgan, and educated at Wycliffe College. He qualified at Faraday House, and at the beginning of the century was a pioneer in installing electric lighting in public buildings in Bristol. Electricity undertakings in many smaller towns were sponsored by him, and he was instrumental in obtaining the Wessex Act, by means of which electricity came to be supplied to rural Berkshire, Wiltshire and Oxfordshire.

He contributed materially to the financing of the permanent foundation of Wycliffe when it became a public school in 1931, and became chairman of its governing body. He was constantly active in improving the amenities of the school, believing that the surroundings in which a boy spent his early years could be a great influence in the development of character.

The National Trust benefited from his gift of a farm and lands of historic interest at Ponterwyd; and at Cranham, of which he was for 33 years chairman of the parish council, he presented a headquarters and camping ground to the Gloucestershire Scout movement.

He was elected a Fellow of the Society in 1929.

NOTES ON BOOKS

THE CRYSTAL GOBLET. *By Beatrice Warde. Sylvan Press*, 1955. 21*s*

The romantic phrase or epithet *The Crystal Goblet*, which is the title of this volume of essays on typography, is also the title of the first essay which has the significant

sub-title of 'Printing should be invisible'. On almost every page you will find such happy, colourful, thought-provoking phrases in close proximity to hard-hitting, down-to-earth, practical sentences that are carefully contrived to suit the particular audience for which they were intended. Could anybody but Mrs. Warde so successfully and charmingly address an audience of art students at the R.C.A. on one occasion, and, on another, lecture a gathering of the Printers' Managers and Overseers Association or of the Library Association?

These 16 essays are gathered together and edited by Mr. Henry Jacob, and comprise certain articles and speeches made by Mrs. Warde over a period of (is it churlish to mention how long?) a quarter of a century. They range from scholarly articles in the *Monotype Recorder*, *The Times Literary Supplement*, the *Penrose Annual* and *Chambers's Encyclopædia* to speeches delivered at Printing Trade meetings and at College of Art speech days. The subjects are almost as various: 'On the choice of typefaces', 'The typography of the Bible', 'An anthology of verse as a typographic problem', 'The pride of craftsmanship', 'Design and management', and 'The artist and typography—a word of warning'.

In the first essay (whose title we have already quoted, and which Mrs. Warde says in her Introduction is a summing up of the book's main ideas) we find the statements: '. . . the most important thing about printing is that it conveys thought, ideas, images, from one mind to other minds'; 'Type well used is invisible *as* type, just as the perfect talking voice is the unnoticed vehicle for the transmission of words, ideas'. 'A book typographer has the job of erecting a window between the reader inside the room and that landscape which is the author's words'.

Most of this volume is about book typography and would be accepted without dissent by all designers, whether traditional or *avant-garde*, but not everybody feels so vehemently against the 'era initiators' as Mrs. Warde does. Though the Bauhaus is best kept outside The Book, its stark functionalism is not out of place in some advertisements.

Those who have met these essays in another form will be glad to meet them again in such a readable book (set in 12 pt. Bembo), and all who are new to printing and publishing will do well to read *The Crystal Goblet* from cover to cover without delay.

JOHN R. BIGGS

FRENCH DRAWING OF THE TWENTIETH CENTURY. *Introduction by Jean Cassou; biographical notes by Philippe Jaccottet. Thames & Hudson,* 1955. 50*s*

In the introduction to this book of modern drawings from France, M. Cassou suggests that the drawings of artists fulfil five functions: 'to record the momentary whims of the living world'; 'to explore the line to its limits, its autonomous and arbitrary conclusions'; 'to assist the intellect in its fearless experiments with form'; 'to establish the plan upon which it (the intellect) can build its constructions'; and, finally, 'to describe nature'. He might have added, that the best drawings often fulfil two, or three of these functions at once.

Another classification is one into sculptors' drawings, painters' drawings and draughtsmen's drawings. All three kinds are represented in this collection—compare the sense of solid form common to drawings as varied as those by Maillol, Giacometti, or Gonzalez with the tone and colour of drawings by Villon, Matisse, Braque or Bonnard, or with the wandering calligraphy of André Masson.

The choice of drawings is an interesting one. As might have been expected, Picasso's quota is larger than that of any other artist and Matisse comes second, but it is odd to find Vallotton with a larger number than Rouault, Bonnard, or Modigliani—his work is pleasant but unexciting, perhaps it was considered that, among all this feast of brilliant ideas and dazzling execution some down-to-earth 'documentary' drawings would not come amiss. A group of Swiss artists are included: Soutter, Auberjonois,

Poncet, and Bosshard. They do not add a great deal to the value of the book and the first two seem, on the evidence here, to be hardly worthy of a place in it.

Drawings are often of particular interest because they range so much more widely in mood and subject matter than the artists' carefully considered oil paintings. This aspect might have been borne in mind a little more when the examples were selected, but it is interesting to have a landscape by Rouault and another by Marie Laurencin as well as a self-portrait by that interesting, short-lived experimenter, Roger de la Fresnaye, which might easily have belonged to the sixteenth, not the twentieth century. It is a pity the superb Matisse drawing on the dust jacket is not repeated inside the book.

On the whole this is an excellent anthology, though, like most anthologies, it tantalizes. The reproductions (in a gravure process) are good, though they are not entirely free of that dull, greyish look one associates with offset processes. It is rather doubtful if any method is really an improvement on the old-established one of the half-tone block on 'art paper'—though, admittedly, the art paper is a great nuisance.

STEPHEN BONE

FROM THE JOURNAL OF 1856

VOLUME IV. *11th July*, 1856

From The Exhibition of Art Treasures of the United Kingdom.

The approved design for the Exhibition Building to be erected in Manchester is now on view at 23, Cockspur Street. Mr. Young, who is constructing the Buildings for the Royal Commissioners at Kensington Gore, is the successful competitor, and he has undertaken to complete the building at Manchester by New Year's Day, for £24,500. It will cover rather more than three acres of ground, which compared to the 19 acres of the Great Exhibition, and the like area of the Crystal Palace, will make it appear but a small structure. Additional room will, however, be afforded by the construction of galleries. The extreme length of the building will be 704 feet, and the extreme breadth 200 feet. The materials employed will be for the most part cast and corrugated iron, glass being used only in the centre of each compartment of the roof. The whole of the interior will be lined with wood, while the end appropriated for the grand entrance will be of ornamental brickwork. The walls on which the pictures will be hung will thus be quite safe, and free from all damp. The *coup-d'œil* of the nave is expected to be very effective and imposing, with its trophies of old armour, costumes, implements of chase, banners, and antiquities, illustrative of English life and history in by-gone times, from the time of Queen Victoria to the time of Queen Anne—from the time of Queen Anne to the time of Queen Elizabeth, and Henry VII, and Edward III, and William the Conqueror; with mediæval remains, even to the antiquities of the remotest period of our history. There will also be groups of sculpture, with its thousand objects in stone, marble, alabaster, plaster, wood, ivory, terra cotta, and bronze. There will also be decorative furniture, with all the art luxuries of material life, and goldsmiths' work, and all the curious devices wrought in precious metals; glass—Venetian, German, French, and English; china, delf, and tapestry. In addition, there will be the great picture gallery, with a fair prospect of that most important, but rarely attained desideratum, good lighting. A site, excellent in all respects, has been chosen. It is entirely free from the manufactories and their smoke; the Manchester South Junction and Altrincham Railway, which is in connexion with all the railways coming into the city, adjoins the plot of ground, so that contributions may be brought into the building without change of carriage, and visitors will be deposited without trouble or extra expense.

THE SOCIETY'S CHRISTMAS CARD, 1956

The subject of this year's Christmas Card is a meeting of the Society of Arts in 1759 at which Benjamin Franklin is depicted, helping to adjudicate entries for an art competition.

The Card, which will be in full colour by Miss Anna Zinkeisen, R.O.I., R.D.I., will measure approximately 7½" x 6". A brief description of the picture will be given inside, and on the opposite page the greeting *With All Good Wishes For Christmas and the New Year*, with space for overprinting the name and address if required.

The Card is produced by the Medici Society, Ltd., exclusively for Fellows of the Society, and should be ready for despatch by the end of September.

Prices given below include envelopes.

PRICES FOR FELLOWS RESIDENT IN THE U.K.

The cards will cost Fellows **resident in the United Kingdom :**

15/6 per dozen for the first five dozen

14/6 per dozen thereafter

1/6 each for orders of less than one dozen.

The **additional** cost of printing name and address is as follows :

22/6 for the first dozen

2/6 for each subsequent dozen.

PRICES FOR FELLOWS RESIDENT OVERSEAS

14/– per dozen

1/3 each for orders of less than a dozen.

The **additional** cost of printing name and address is as follows :

12/6 for the first dozen

1/6 for each subsequent dozen.

All prices include postage at ordinary rates. Cards can be sent by air mail, if requested, at the appropriate additional cost.

Please use the Order Form on the back

ORDER FORM

To the Secretary

The Royal Society of Arts, 6–8 John Adam Street, Adelphi, W.C.2.

From

Address to which cards are to be despatched

I wish to order Christmas cards (*and to have my name and address printed as instructed below) A remittance for is enclosed in accordance with the prices quoted overleaf (*and includes the necessary amount for the extra printing).

*Delete if printing of name and address is not desired

INSTRUCTIONS FOR PRINTING NAME AND ADDRESS

(Please write in block capitals and give exact wording and punctuation required)

Name(s)

Address

THE ROYAL SOCIETY FOR THE ENCOURAGEMENT OF ARTS, MANUFACTURES AND COMMERCE

PATRON: HER MAJESTY THE QUEEN

Full particulars relating to the work of the Society and conditions of membership and associate membership may be obtained from the Secretary.

The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

All other communications for the Society should be addressed to THE SECRETARY, ROYAL SOCIETY OF ARTS, 6–8 JOHN ADAM STREET, ADELPHI, LONDON, W.C.2. Telephone number: Trafalgar 2366. Telegrams: Praxiteles, Rand, London.

London: Printed by GEO. BARBER & SON LTD., 23 Furnival Street, E.C.4, and published for the ROYAL SOCIETY OF ARTS
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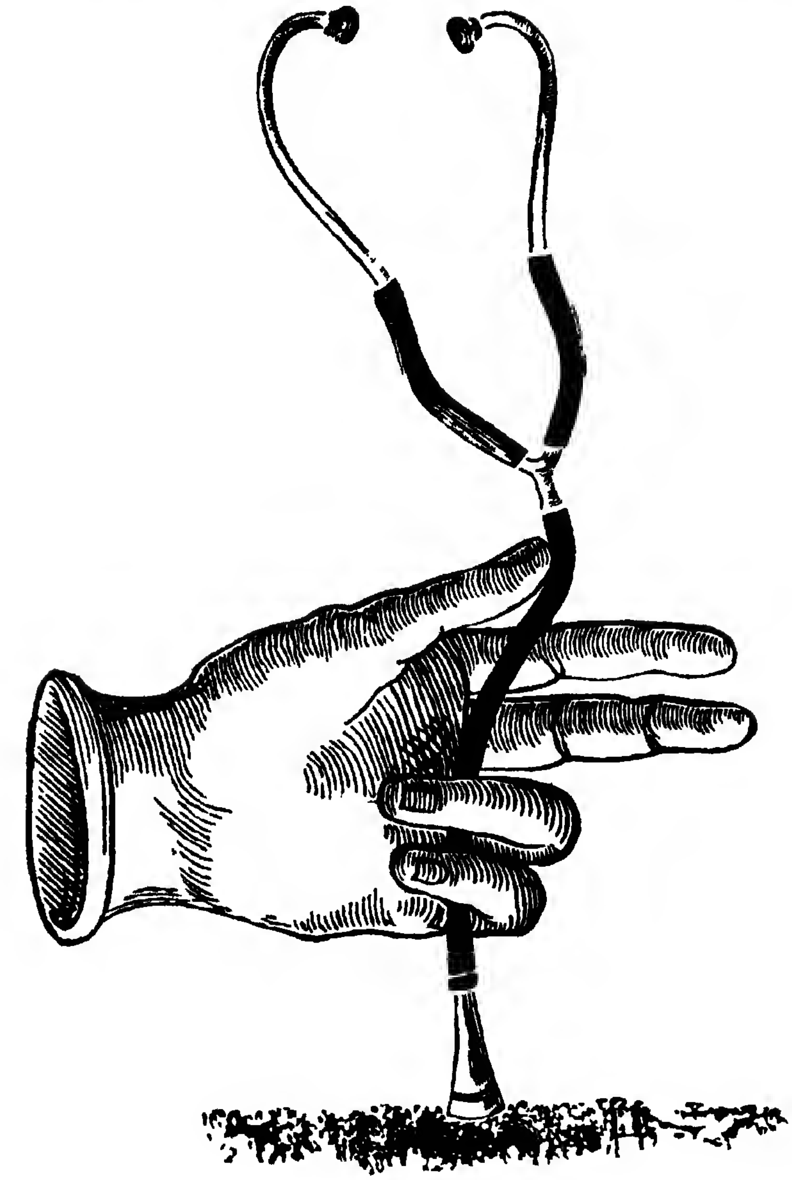
Journal of the Royal Society of Arts

NO. 4982 20 JULY 1956 VOL. CIV

LONDON

THE ROYAL SOCIETY OF ARTS, JOHN ADAM STREET, ADELPHI, W.C.2

PRICE TWO SHILLINGS AND SIXPENCE



Journal of the Royal Society of Arts

NO. 4982 FRIDAY, 20TH JULY, 1956 VOL. CIV

ELECTION OF CHAIRMAN OF COUNCIL

At the meeting of the Council held on 9th July, Dr. R. W. Holland, O.B.E., M.A., M.Sc., was unanimously re-elected Chairman of the Council for the coming year.

SIGN POSTS

The Special Activities Committee has recently discussed with officials of the Ministry of Transport a number of points connected with the lettering, placing and legends of street and road signs. In particular the Committee expressed criticism of sign-posts on country roads, on the score both of the position at which they are placed, which makes them often unreadable at night, and of the inconsistency and inaccuracy in the information they give.

The Ministry were satisfied that their new general scheme for sign-posting which is now in process of being applied throughout the country is adequate, but recognized that mistakes might be made in its application. They added that they would always be glad to hear any specific criticism and it was suggested that Fellows of the Society might be able to help in this matter.

Accordingly if any Fellow has any specific points of criticism to make in connection with either the siting of particular sign-posts or with the indications they carry and would care to let the Secretary know of these they will then be transmitted by him to the Ministry.

THE SOCIETY OF CHEMICAL INDUSTRY

The Society of Chemical Industry celebrated on 10th July the 75th anniversary of its foundation in 1881 and the Society was represented by Sir John Simonsen and the Secretary at a ceremony at which congratulatory addresses were presented. Following the precedent set by the Faculty of Royal Designers for Industry and the Royal College of Art at the Society's own Bicentenary, the Society presented its congratulations in the form of an engraved glass bowl and not as an Illuminated Address

Sir John Simonsen also attended the 75th Anniversary Banquet on Wednesday, 11th July, and was invited to reply thereat to the toast of 'The Guests'.

MEETING OF COUNCIL

A meeting of Council was held on Monday, 9th July, 1956. Present: Dr. R. W. Holland (in the Chair); Dr. W. Greenhouse Allt; Sir Alfred Bossom; Sir Charles Dodds; Mr. P. A. Le Neve Foster; Mr. John Gloag; Sir Ernest Goodale; Mr. Milner Gray; Sir William Halcrow; Mr. A. C. Hartley; Sir Harry Lindsay; Mr. F. A. Mercer; Mr. Oswald P. Milne; Sir Selwyn Selwyn-Clarke; Sir John Simonsen; Mr. G. E. Tonge; Dr. Barnes Wallis and Sir Griffith Williams; with Mr. K. W. Luckhurst (Secretary) and Mr. David Lea (Assistant Secretary).

ELECTIONS

The following candidates were duly elected Fellows of the Society:

Balsom, Herbert Henry, New Barnet, Herts.
Batt, William L., C.M.G., M.E., D.Eng., Sc.D., Philadelphia, Pennsylvania, U.S.A.
Baxter, Thomas William, A.L.A., Salisbury, Southern Rhodesia.
Beard, Bernard Frederick, Belstone, Devon.
Bennett, Raymond Wordsworth, B.Sc., Calcutta, India.
Beukes, Pieter, M.A., B.Litt., Cape Town, South Africa.
Brown, Frederick, B.Sc., Brandon, Co. Durham.
Carter, John David Armishaw, London.
Darlington, Cyril Edward, T.D., B.Sc., A.M.I.Mar.E., Gateshead, Co. Durham.
Dunbar, Miss Evelyn Mary, A.R.C.A., Hinxhill, Kent.
Evans, Douglas Reginald, London.
Fiford, David Ernest, London.
Gilchrist, Charles William, Istanbul, Turkey.
Graham, Professor Victor Edward, B.S.A., M.S., Ph.D., Saskatoon, Saskatchewàn, Canada.
Hammond, Richard Deaves, London.
Hay, Alexander, Glasgow.
Holt, Miss Constance Mary, Horsforth, Yorks.
James, Lionel David St., Bromley, Kent.
Knott, Joshua Robert, Welling, Kent.
Line, John, London.
Mahoney, Charles, A.R.C.A., Wrotham, Kent.
O'Neil, Commander Edgar Augustine, U.S.N.R., Englewood, New Jersey, U.S.A.
Peek, Geoffrey Walter, F.R.I.C.S., London.
Schary, Saul, New York, U.S.A.
Slattery, Brian George, Berkhamsted, Herts.
Smith, Alan Herbert, Kettering, Northants.
Walsh, Fred, A.R.C.A., A.T.D., Maidenhead, Berks.
Wanamaker, Professor John Frederick, M.A., Ph.D., Elsah, Illinois, U.S.A.
Webb, Thomas Basil, B.Sc., M.I.Mech.E., Hayes Common, Kent.

The following has been duly elected an Associate Member of the Society:

Stedman, John Edward, Sevenoaks, Kent.

BENJAMIN FRANKLIN MEDAL

The following were appointed in accordance with the provisions of a Council Resolution of 9th April, 1956, as a committee to select a name for the first award of the Benjamin Franklin Medal, which is due to be made in January, 1957: The Chairman of the Council: The Master of the Faculty of R.D.I.; Sir Ernest Goodale; the Earl of Halsbury and Mr. A. C. Hartley.

The question of a design for the medal was also considered.

LOCAL RATES

It was agreed that a Proposal for the exemption of the Society from liability for Local Rates under the Scientific Societies Act, 1843, should be lodged with the Local Valuation Officer forthwith.

OTHER BUSINESS

A quantity of financial and other business was transacted.

TWO HUNDRED AND SECOND ANNUAL GENERAL MEETING

WEDNESDAY, 4TH JULY, 1956

SIR ERNEST GOODALE, C.B.E., M.C., *a Vice-President of the Society, in the Chair*

The Two Hundred and Second Annual General Meeting was held on Wednesday, 4th July, 1956, at 3 p.m., at the Society's House, in accordance with the Bye-Laws, for the purpose of receiving the Council's Report and the Financial Statements for 1955, and for the election of officers.

The Secretary read the Notice convening the meeting and proved that it had been duly exhibited and published, as required by the Bye-Laws.

Sir Ernest then explained that he was taking the Chair as both Dr. Holland, the Chairman of Council, and Mr. Munro Runtz, his immediate predecessor, were indisposed and the Earl of Radnor was out of London.

The Minutes of the last Annual General Meeting, held on 6th July, 1955, were then taken as read, the Secretary having summarized their contents, and were signed by the Chairman as a correct record.

The Chairman then called upon the Secretary to summarize the Annual Report of the Council:

ANNUAL REPORT OF THE COUNCIL

202nd SESSION, 1955–1956

I. HIS ROYAL HIGHNESS THE PRESIDENT

His Royal Highness the President has visited the Society's House on three occasions during the past year. On 26th October he came to present the R.D.I. Diploma to Mr. Uffa Fox and the Bicentenary Medal to Sir Charles Tennyson; on 7th December he attended the Annual Reception of the Faculty of Royal Designers for Industry and on 28th March he honoured the Society's Council by taking lunch with them in the Library.

On 9th November His Royal Highness received the Council at Buckingham Palace for the presentation to Dr. Vaughan Williams of the Albert Medal awarded to him last June.

II. ALBERT MEDAL

With the approval of the President, the Albert Medal for 1956 has been awarded to Sir Henry Dale, O.M., G.B.E., M.D., F.R.S., for 'eminent service to science, particulary physiology'.

III. ROYAL DESIGNERS FOR INDUSTRY

The following new appointment has been made to the Distinction:

Reynolds Stone, C.B.E. (*lettering*).

Mr. Milner Gray was elected Master of the Faculty for 1955/56 and Sir Francis Meynell, the immediate past-Master, served as Deputy Master.

In accordance with the practice established in 1954 a special meeting of the Society was held on 26th October for the presentation to Mr. Uffa Fox of his Diploma, and the Society and the Faculty were honoured by the presence at this ceremony of His Royal Highness The Duke of Edinburgh, who made the presentation. The presentation was followed by an Address by Mr. Milner Gray, Master of the Faculty, and afterwards His Royal Highness honoured the Faculty by taking luncheon with them at Kettner's Restaurant.

The Faculty held their sixth Annual Reception at the Society's House on 7th December and were again greatly honoured by the presence of His Royal Highness The Duke of Edinburgh.

The Faculty were represented by the present Master on the committee which organized the memorial exhibition, held at the Victoria & Albert Museum from 7th October to 24th November, 1955, of the work of the late E. McKnight Kauffer, the first recipient of the Honorary distinction of Royal Designer for Industry.

Miss Susie Cooper, a Member of the Faculty who is also a Fellow of the Society, has made a generous gift to the Society of a tea service for use in the Council Room.

IV. BICENTENARY MEDAL

The third Bicentenary Medal, which is for annual award to those who 'in a manner other than as industrial designers have exerted an exceptional influence in promoting art and design in British industry', has this year been awarded to Dr. W. J. Worboys, Chairman of the Council of Industrial Design.

The second Bicentenary Medal, which, as recorded in the last Annual Report, was awarded to Sir Charles Tennyson, C.M.G., was presented by His Royal Highness the President, as mentioned in Section 1 above.

V. PORTRAIT OF LORD RADNOR

The portrait of the Earl of Radnor, Chairman of Council during the Society's Bicentenary Year, which was commissioned by the Society as a permanent memorial of that occasion, has now been completed by Professor Rodrigo Moynihan, R.A., and is at present on exhibition at the Royal Academy. On the closing of the Summer Exhibition the portrait will be hung in the Society's library.

VI. ENDOWED PRIZES

Offers of prizes were again made this year under the Benjamin Shaw, Fothergill and Howard Trusts. One prize of £50 was awarded under the Howard Trust; one of £20 under the Benjamin Shaw Trust and one of £20 under the Fothergill Trust. Full details of the results of the competitions were published on page 797 of the *Journal* for 14th October, 1955.

VII. EXAMINATIONS—CENTENARY YEAR

The first examinations conducted by the Society were held in June, 1856, when 203 papers were worked by 52 candidates who attended at the Society's House in London, and came from Mechanics Institutes in various parts of the country. Now, the examinations are held at about 900 centres in all parts of Great Britain and Ireland and in various parts of the British Commonwealth, under the control of the local education authorities or of government-sponsored bodies. Examinations in English are also held at specially arranged centres in certain foreign countries, under the control of an official of the British Embassy or of the British Council.

Number of Entries

In this, the centenary year of the examinations, it is very gratifying to be able to report once again a record number of entries for the various examinations conducted by the Society. The table of subject-entries which follows shows that the record total of last year has been exceeded by 15,548.

	1955–56	1954–55
(*a*) Ordinary (Single-subject) Series	153,173	142,622
(*b*) Oral Tests	4,551	3,465
(*c*) School and Senior School Commercial Certificates ...	16,398	14,952
(*d*) Grouped Course	16,201	12,961
(*e*) Road Transport Subjects	1,256	1,142
(*f*) Teacher's Certificate in Shorthand	618	652
(*g*) Teacher's Certificate in Typewriting	413	403
(*h*) British Transport Commission (Preliminary examination of candidates under Apprenticeship Schemes) ...	1,146	1,976
(*i*) British European Airways (Special proficiency tests in Shorthand and Typewriting)	117	128
(*j*) Royal Air Force Administrative Apprentices (Scheme of endorsement of certificates awarded by the Air Ministry)	125	149
	193,998	178,450

Centenary Prizes

To mark the occasion of the centenary of the first examination the Council have approved the award of special Centenary Prizes to candidates submitting the best papers in certain subjects, or groups of subjects, at the combined Easter, Whitsun and Summer Series of 1956. In addition to the cash prizes, the successful candidates will receive specially inscribed certificates.

Negotiations with the Ministry of Education

In November, 1954, the Council submitted a resolution to the Ministry of Education on the subject of examinations for secondary schools, and last January a deputation of the Council was received by officials of the Ministry when the resolution was discussed in detail. The reply from the Ministry was incorporated in Circular 289 (see Report on Examinations, published in the *Journal* for 11th November, 1955). In March, 1956, the Society submitted to the Ministry their detailed comments on the points raised in Circular 289, and reiterated their recommendation that, at the discretion of the head teacher, pupils of secondary schools in their sixteenth year should be allowed to take appropriate examinations such as those conducted by the Society and by bodies of similar standing.

Miscellaneous

Six Silver Medallists at the Society's examinations in 1955 have been elected to Associate Membership.

The Worshipful Company of Clothworkers has again generously contributed towards the cost of the silver and bronze medals.

A fuller report on the Society's examinations during the past year will be published in the *Journal* in the autumn.

VIII. INDUSTRIAL ART BURSARIES COMPETITION

The Society's annual competition for the award of travelling bursaries to students of industrial design shows by its continued expansion that it is rendering an important service to art schools and industry.

The competition held during 1955 was divided into 15 sections (two more than in 1954), covering the following fields of industrial design respectively, namely: *domestic electrical appliances, electric light fittings, domestic gas appliances, domestic solid-fuel-burning appliances, carpets, dress textiles, women's fashion wear, furnishing textiles, acrylic sheet ('Perspex') articles, laminated plastics, P.V.C. plastics sheeting, footwear, furniture, jewellery and wall-paper.*

Three Bianca Mosca awards, totalling £350 in value, and ten ordinary bursaries of £150 and seven of £75 each, have been awarded to successful candidates. The 13 bursary winners who were eligible for the award of Associate Membership have now been elected.

Candidates were required both to undergo a set test carried out under invigilation, and also to submit with the work done in that test examples of work done by them in the ordinary course of their studies. An illustrated report of the competition was published, of which a summary was included in the *Journal* for 2nd March, 1956, and the usual exhibition of winning and commended designs was held in the Society's House in May. The exhibition was formally opened for the first time since the war, the opener being the Rt. Honble. Sir David Eccles, K.C.V.O., M.P., Minister of Education. A further touch of brilliance was given to the display by the use of a set of new lighting fittings which have been acquired for the Society's exhibition screens through the J. A. Milne bequest. Immediately after the closing of the exhibition at the Society's House the designs were removed to Olympia for inclusion in the Production Exhibition and Conference promoted by the Institution of Production Engineers, where they created a great deal of interest, and arrangements have also been made for further showings in Falmouth, Belfast and Birmingham, following last year's practice whereby the exhibition was shown in Canterbury, Gloucester and Worthing.

Nineteen of the candidates successful in previous competitions made tours abroad during the year. Most of them visited Scandinavia, France or Italy, and other countries visited were Holland, Norway, Switzerland and Western Germany; a number of the candidates also undertook courses of study and visited various factories and studios in this country. Details of all these tours and courses were included in the report mentioned above. Of the winning candidates in the most recent competition, eight have already begun their tours on the Continent; and the remainder will be setting out either later this year or in the spring of 1957. Arrangements have also been made for two of the commended candidates to gain practical experience by visiting factories in this country.

The Council wish to express once again their appreciation of the generous

donations from industrial bodies and firms which make this competition possible, and which encourage them and the Bursaries Board in their firm belief that the competition is worth while. It has accordingly been decided to organize a similar competition during the present year, and to offer awards of the total value of £3,350, of which £3,135 has already been subscribed or promised, for design in 17 different industrial fields, thus showing a still further expansion. All the sections included in the 1955 Competition will again be represented, with the exception of that for domestic gas appliances, and in addition there will be three new sections, for the design of domestic glassware, pottery and cinema and television settings. Details were given in an announcement published in the *Journal* for 11th May, 1956.

IX. THOMAS GRAY MEMORIAL TRUST

Prizes for Ships' Apprentices

Fifteen prizes, of a total value of £74 17*s.* 4*d.*, were awarded in connection with the examinations conducted by the Merchant Navy Training Board. The prizes consisted of five silver medals, five bronze medals and five nautical instruments.

Scholarships for Deck-Boys and Young Seamen

In 1955 the Trust made a grant of £100 towards the provision of scholarships for deck-boys and young seamen, which are mainly financed by the Trust but administered by the Seafarers' Education Service, and 18 scholarships were awarded. These scholarships take the form of a four-year correspondence course together with the necessary text books and it is estimated that about one in ten who rise from deck status are now scholars under this scheme.

Training Ship Prizes

Prizes, to a total value of £30, offered to the training ships *Indefatigable*, *Arethusa* and *Mercury* for the boy in each ship who, in the opinion of his officers, would make the best sailor, were awarded to W. W. Hampson of *Indefatigable* (£10), Brian George Britnell and Robert Tullett of *Arethusa* (£5 each), and Roger Thrussell of *Mercury* (£10). The silver medal offered as a navigation prize in the South African Nautical College *General Botha* was awarded to Ellard Krauss.

Extra Master's Certificate Examinations

The Silver Medal offered to the candidate who obtained the highest marks in the Ministry of Transport's Examinations for the Extra Master's Certificate in 1955 has been awarded to Mr. William Stanley Gordon Morrison.

Thomas Gray Memorial Bursaries Scheme

Three bursaries were awarded in 1955 under the Thomas Gray Memorial Bursaries Scheme to cadets from the School of Navigation, Southampton, H.M.S. *Conway* and H.M.S. *Worcester* respectively. The scheme, which is now in its third year, gives help to cadets in financial difficulties who without it might be compelled to abandon their training.

Deed of Professional Merit

Seven submissions were received in connection with the offer of an award of £50 for a deed of outstanding professional merit performed by a member of the British Mercantile Marine between October, 1954, and September, 1955, and on the unanimous recommendation of the Judges the award was made to Chief Officer C. S. Owston of the M.S. *Liparus* for the skill which he had shown as officer in charge of a life-boat concerned in a rescue operation in St. George's Channel.

X. *EVENING DISCUSSION MEETINGS*

Although the attendances at the three Evening Discussion Meetings held in the last Session were not very encouraging, the Council decided to hold a further experimental series on the same lines in the present Session. Three meetings were held in the Library, on 1st February, 29th February and 28th March respectively, under the supervision of the Special Activities Committee, and the Society was again most fortunate in the speakers who opened each discussion.

At the first meeting Mr. Raymond Spottiswoode introduced the subject of 'Recent Developments in Cinema Technique'; at the second Mr. Denzil Batchelor, Sports Editor of *Picture Post*, introduced the subject of 'Sport—with some reference to the growth of professionalism'; and at the last meeting Dr. Stanley Gooding was the opening speaker on 'The Use of Leisure'.

The primary object of the meetings, as in the previous Session, had been to provide an opportunity for informal discussion, particularly by younger members of the Society, many of whom are not able to attend Ordinary Meetings in the afternoon. Unfortunately, however, the number of younger members in the audience was, in both series, disappointing, and the attendance was considerably reduced in the three meetings this year. The Council have therefore decided not to continue the experiment for another Session although an occasional informal discussion may be arranged, should a suitable subject present itself.

XI. *MARKET RESEARCH CONFERENCE AND ESSAY COMPETITION*

The effort made by the Society last year, in organizing an essay competition, to advocate market research as an essential means of improving the export trade of Great Britain, was continued and the Society held a one-day Conference on this subject in November. It was supported by the Association of British Chambers of Commerce, the British Export Trade Research Organisation, the Federation of British Industries, the Institute of Export and the National Union of Manufacturers.

The Conference was opened by the Right Honble. A. R. W. Low, the Minister of State at the Board of Trade, and Sir Ernest Goodale, Mr. Leslie Gamage and Mr. Roger Falk took the chair at various stages of the proceedings. The speakers included Mr. Lincoln Steel, Mr. Martin Maddan and Mr. Alastair

Sedgwick, and the Conference was fully attended by a large number of Directors from small and large firms interested in export questions all over the country.

At the end of the Conference the prize of £500, which had been offered in the 1955 Essay Competition and provided by the British Export Trade Research Organisation, was presented to the winner, Mr. Peter Clare Beauchamp, the Assistant Market Information Officer of a London firm of manufacturing chemists. Altogether 25 essays were submitted, and an additional prize of £25 was awarded to Mr. Garth Edward Glasson, a South African employed by a firm of lace exporters in Nottingham.

The Essay was published in the *Journal* for 25th November, 1955.

XII. BENJAMIN FRANKLIN CELEBRATIONS

The Society, which has been in touch for some time with other interested organizations, took an active part in the recent celebrations of the 250th Anniversary of the birth of Benjamin Franklin.

On 11th January the Society was represented by the Chairman of Council and the Secretary at a memorable ceremony at Franklin House, Craven Street, which was Franklin's London home, when one of two Franklin medals struck by the City of Philadelphia was presented by the Mayor of that city to Sir Winston Churchill.

On 18th January it was the turn of the Society to receive a medal. At the close of the Trueman Wood Lecture by Professor E. N. da C. Andrade on 'Benjamin Franklin in London', Dr. Myron Koenig, the Chief Cultural Attaché (in the absence in the United States of the American Ambassador), presented the medal struck by the United States Congress for award, primarily, to the various bodies still existing of which Franklin was a member. The medal (which was described and illustrated on page 234 of the *Journal* for 3rd February, 1956) was accepted on behalf of the Society by the Chairman of Council, Dr. R. W. Holland.

The Society is itself now preparing a Benjamin Franklin medal, which will serve to commemorate not only the 250th anniversary, just past, of Franklin's birth but also the 200th anniversary, in September, of his election to membership of this Society. This medal will be for award annually 'to individuals who have attained early distinction, with promise of further achievement, in the promotion of arts, manufactures and commerce'.

This year of celebration has also been a most appropriate occasion for an interesting exchange of early documents connected with Franklin between the Royal Society of Arts and the American Philosophical Society, which was founded by Franklin in Philadelphia in 1743. Details of this transaction were published on page 534 of the *Journal* for 8th June, 1956.

XIII. EXHIBITION OF EUROPEAN MEDALS

The 'Exhibition of European Medals', 1930–1955, which was organized by the Society and displayed at the Society's House in June, 1955, has since been shown

in museums or art galleries in the following cities: Sheffield, Norwich, Lincoln, Leicester, Edinburgh and Cardiff. Appreciative messages describing the considerable interest aroused by the Exhibition have been received from the heads of each of the institutions concerned.

The Exhibition has now been dispersed.

XIV. FILM EVENINGS

Film Evenings have once again attracted large audiences of Fellows and their guests. Four programmes were arranged during the session and, as has been the custom since the programmes commenced, in most cases the producers or directors of the films screened were present to introduce their films.

The programmes included *The Rival World*, *Thursday's Children*, *Heart of England*, *Man with a* 1,000 *Hands*, *Elizabethan Express*, *Magic Strings* and the film record of Captain Scott's ill-fated Antarctic Expedition, *Ninety Degrees South.*

XV. SCIENCE AND INDUSTRY COMMITTEE

The Science and Industry Committee, which was initiated by the British Association and since 1954 has been sponsored jointly by the Society, the Association and the Nuffield Foundation, has continued its investigations into the possibility of speeding-up the application to industry of the results of scientific research, and is now actively engaged in the preparation of its Report, which it is expected will be published in the Spring of 1957.

XVI. PAXTON MEMORIAL TRUST

In the Joint Report, published on 20th December, 1955, of the General Purposes Committee and the Parks Committee of the London County Council on the subject of 'Crystal Palace Development', reference was made to the proposed provision in the Crystal Palace grounds of a memorial to Sir Joseph Paxton, the originator of the old Crystal Palace, and the report added, as a result of a suggestion made some time ago by the Society, that this subject 'is one in which we understand that the Royal Society of Arts might be willing to co-operate in certain respects'. The Society is now engaged in active discussions with a view to the organization of a competition for designs for the garden which will be the main feature of the proposed memorial.

XVII. PURCHASE TAX ON MEDALS

A reference made by the President of the Royal Academy, when opening the Society's Exhibition of European Medals, to the serious inhibiting effect of purchase tax on this form of art was considered by the Special Activities Committee and recommended to the Council as a matter in which the Society might appropriately take action. Representations were accordingly made in the appropriate quarters and, at the suggestion of the Society, similar representations

were also made by the President of the Royal Academy and the President of the Royal Society of British Sculptors. The immediate outcome of this action was merely to establish the fact that bronze medals were then, subject to certain conditions, free from purchase tax, a fact that was not fully appreciated by all concerned. Since then, however, the Chancellor of the Exchequer has found it possible, in his autumn (1955) budget, similarly to free gold and silver medals from tax, subject to the same conditions.

XVIII. IMPERIAL INSTITUTE

At its March and April meetings the Council had under consideration the proposal to demolish the building of the Imperial Institute in order to make way for the extension of the Imperial College of Science. As a result of their deliberations the Council decided to address a letter to the Lord President of the Council, the Rector of the Imperial College of Science and Technology, the Clerk of the London County Council and the Secretary of the Royal Fine Art Commission. This letter, the text of which was published on page 397 of the *Journal* for 13th April, 1956, appealed for further consideration to be given 'to the possibility of adapting at least the tower and *façade* to the uses of the enlarged Imperial College'.

It has now been announced by Mr. Henry Brooke, Financial Secretary to the Treasury, that the revised plans for the development of the Imperial College permit the retention of the tower as a free-standing *campanile* (see the *Journal* for 6th July, 1956).

XIX. COLLABORATION WITH OTHER ORGANIZATIONS

The Council wish to express the pleasure which they have experienced in again collaborating with other organizations in various matters during the past year. These include the erection of a memorial to John Nash at All Souls' Church, Langham Place, now reaching fruition, the arrangements for the recent Franklin 250th Anniversary Celebrations and the Perkin Centenary Celebrations, the organization of the McKnight Kauffer Memorial Exhibition, the Science and Industry Committee (referred to in Section XV above) and the Conference on Export Market Research.

XX. THE LIBRARY

The Society's Archivist, Mr. D. G. C. Allan, was appointed Curator-Librarian in succession to Miss M. L. Clark. Work on the loose archives is continuing, and some bound volumes of eighteenth-century letters are also being indexed.

The limit of the holding capacity of the Library having been reached, a number of redundant works have been disposed of. An explanation of the policy which will be followed in future acquisitions for the Library was published in the *Journal* for 11th May, 1956.

The basement immediately below the Library has been thoroughly cleaned and redecorated. Fluorescent lighting and an electric ventilator have been fitted, and it can now be used as an emergency reading room,

The Library has received a number of generous gifts and bequests, the most notable being the legacy from the late Mrs. N. W. Michael, to be known as the *Fred Henry Andrews Trust* (see Section XXIV below). Books presented include nine volumes of the *Survey of World Textiles.*

XXI. THE SOCIETY'S CHRISTMAS CARD

For the seventh successive year the Society produced a special Christmas card in 1955 for the use of Fellows, and the record number of 25,000 was sold. The subject was what is believed to be the first Christmas card produced in this country. It was published by Henry Cole in 1843. As Fellows will remember, Cole was Chairman of the Council of the Society in 1850, and again in 1852.

XXII. FELLOWSHIP

It was hardly to be expected that the last 12 months would compare favourably as regards increase in membership with the previous year, when public attention was focussed upon the Society because of the Bicentenary. However, the number of Fellows on the roll after the Council meeting in June was 6,228. as compared with 6,216 at the corresponding period of 1955. Considering present circumstances this small increase is, taken by itself, not unsatisfactory, but, as is stressed elsewhere, the Society, like its members and potential members, is feeling the pinch of inflation, and if it is to fulfil the *rôle* for which its present size and prestige qualify it, a continuing increase of income, by subscriptions, is seriously needed. The Council therefore earnestly hope that Fellows will make it a matter of concern to propose for election the names of persons whom they consider suitable.

XXIII. OBITUARY

By their death during the past year the Society unhappily lost the valuable services of two Members of its Council—Sir Atul Chatterjee, a Vice-President, who had served continuously from 1928 to the time of his death and was Chairman in 1939–40, and Lord Horder who was re-elected to the Council only a little more than a month before he died. It also regrets the loss of two former Vice-Presidents, Mr. W. H. Berry and Sir Montague Hughman, the senior Honorary Corresponding Member, Colonel N. T. Belaiew, who had served since 1917 as Honorary Corresponding Member in Paris, and a member of the Commonwealth Section Committee, Sir Alexander Murray. In addition, the Society has been deprived of some of its members of longest standing, including, Mr. A. E. Habershon (1891), Sir Spencer Portal (1892), Sir William Himbury (1896), the Earl of Harrowby (1901) and Mr. H. R. Abercrombie (1904).

Other obituary notices published in the *Journal* included those of Lord Altrincham, Sir Charles Bartlett, Sir Charles Dundas, Sir Alexander Korda, Sir David Russell, Mr. A. V. Sugden, Dr. S. Whitehead and Mr. J. H. Whitehouse.

XXIV. THE FRED HENRY ANDREWS TRUST

Under the Will of the late Mrs. N. W. Michael the Society has received a bequest of £1,000 for the establishment of a Trust the income from which is to be used for the purchase of books for the Library. This Trust bears the name of Mrs. Michael's father, Mr. Fred Henry Andrews, who has served on the Society's Council almost continuously since 1935.

XXV. NEW COUNCIL

The death of Lord Horder, and the resignation owing to ill health of Mr. William Will, created two vacancies in the Council list during the year. These were filled by Mrs. Mary Adams and Professor Sir Charles Dodds.

In accordance with the Bye-Laws four Ordinary Members of Council must resign at the Annual General Meeting- the two senior, and two by reason of least attendance. These four are Mr. F. H. Andrews, Professor Sir Albert Richardson, Mr. A. R. N. Roberts and Mr. J. G. Wilson, and it is recommended that their places should be filled by Sir Henry Cohen, Sir William Halcrow, Mr. G. E. Tonge and Dr. B. N. Wallis.

XXVI. HONORARY CORRESPONDING MEMBERS IN NORTH AMERICA

The Council have recently been giving special attention to the fostering of an interest in the Society's work in the British Commonwealth and in the United States of America and have, during the past year, appointed four additional Honorary Corresponding Members in Canada and an Honorary Corresponding Member for the North-Eastern States of the United States. Details of these appointments were published in the issues of the *Journal* for 28th October, 1955 and 6th January, 1956.

XXVII. STAFF

As reported above, Miss M. L. Clark has resigned her appointment as Librarian and has been succeeded by Mr. D. G. C. Allan, previously the Society's Archivist, as Curator-Librarian.

XXVIII. LOCAL RATES

The Council have been giving careful consideration to the Society's position regarding local rates both under Section 8 of the Rating and Valuation (Miscellaneous Provisions) Act, 1955, and the Scientific Societies Act of 1843.

XXIX. FINANCE

The Income and Expenditure Account for 1955 shows an excess of income over expenditure of £3,862, as compared with £2,274 in 1954, which certainly gives cause for satisfaction. Nevertheless, it must be stressed that since the end of 1955 increases have taken place in the cost of producing and posting the *Journal*, and also in salaries, wages and superannuation and general expenses, so that the accounts for the current year are likely to show a far less rosy outcome. In the light of these circumstances the Council are, of course, exercising a very careful supervision over all expenditure.

XXX. STANDING COMMITTEES

A list of those appointed to serve on the various standing committees of the Society, and of the Society's representatives on the governing bodies and committees of certain other organizations, was published in the *Journal* for 25th November, 1955.

XXXI. PAPERS AND LECTURES

The unspecialized nature of the Society enables it to cover a wide field of interesting and important subjects, and the Society is fortunate to receive the support of distinguished lecturers who are willing to devote valuable time to preparing papers for publication in the Society's *Journal* and to reading them at its meetings. To these it is deeply indebted and sincerely grateful.

Last Session's programme maintained the usual high standard, and the subjects dealt with ranged from historical accounts of Benjamin Franklin, John Flaxman and Sir Joshua Reynolds to the latest developments in television and automation.

The full list of papers and lectures is as follows:

A. ORDINARY MEETINGS

Chairman's Inaugural Address
ART IN EDUCATION. *Dr. R. W. Holland* (page 6)

Trueman Wood Lecture
BENJAMIN FRANKLIN IN LONDON. *Professor E. N. da C. Andrade* (page 216)

Peter Le Neve Foster Lecture
ELECTRONIC PHOTOGRAPHY. *C. G. Mayer* (page 578)

Alfred Bossom Lecture
PLANNING AGAINST NOISE. *H. Bagenal* (page 303)

E. Frankland Armstrong Memorial Lecture
RESEARCH IN INDUSTRY. *Dr. B. K. Blount* (page 108)

Pope Memorial Lecture
THE DEBT OF CHEMISTRY TO MEDICINE. *Professor Sir Charles Dodds* (page 671)

Fernhurst Lecture
INSECT PHYSIOLOGY IN RELATION TO INSECTICIDES. *Professor. V. B. Wigglesworth* (page 426)

Inaugural Fred Cook Memorial Lecture

THE LIFE AND WORK OF SIR JOSHUA REYNOLDS, P.R.A. *A. Gwynne-Jones* (8th February)

Papers

Special Meeting

(Presentation of R.D.I. Diplomas and the Bicentenary Medal.) Oration THE CREATIVE URGE. *Milner Gray* (page 14)

Ordinary Meetings

JOHN FLAXMAN, R.A. (1755–1826). *Dr. John Thomas* (page 43)
PUBLIC RELATIONS AND ADVERTISING TODAY. *Sir Stephen Tallents* (page 194)
SCIENTIFIC ASPECTS OF THE DETECTION OF CRIME. *Dr. L. C. Nickolls* (page 181)
LATIN-AMERICAN ARCHITECTURE. *Professor Henry-Russell Hitchcock* (page 344)

Symposium of three papers on A NEW APPROACH TO FURNITURE DESIGN

RESEARCH IN THE FURNITURE INDUSTRY. *M. J. Merrick* (page 368)
ITS APPLICATION TO FURNITURE CONSTRUCTION. *T. Kotas* (page 373)
ITS EFFECT ON THE CHARACTER OF FURNITURE. *Robin Day* (page 379)

DESIGNING FOR TELEVISION. *F. H. K. Henrion* (page 439)
THE ARITHMETIC OF THE MUSICAL SCALE. *L. H. Bedford* (page 465)
THE BRITISH GLASSHOUSE INDUSTRY. *Dr. W. F. Bewley* (page 515)
A NEW CONCEPT IN THEATRE DESIGN. *Norman R. Branson* (29th February)
THE TOURIST INDUSTRY. *J. G. Bridges* (page 567)
T. H. HUXLEY AND TECHNICAL EDUCATION. *Dr. Cyril Bibby* (18th April)
BEAUTY IN DANGER—THE RURAL SCENE. *Sir George Pepler* (page 609)
BEAUTY IN DANGER—THE URBAN SCENE. *Professor Sir Hugh Casson* (page 627)
AUTOMATION. *Lord Halsbury* (page 535)
EXAMINATIONS: DO WE STILL NEED THEM? *Sir Griffith Williams* (30th May)
THE INFLUENCE OF NATIONAL CHARACTER ON DESIGN. *Paul Reilly* (6th June)
PEATY TERRAIN: ITS INFLUENCE AS A FACTOR CONTROLLING DEVELOPMENT IN GREAT BRITAIN AND CANADA. *Professor Norman W. Radforth* (3rd July)

B. COMMONWEALTH SECTION

Eight papers and lectures were delivered to the Commonwealth Section during the Session.

Thomas Holland Memorial Lecture

THE WORK OF THE COLONIAL DEVELOPMENT CORPORATION. *H. Nutcombe Hume* (12th April)

Neil Matheson McWharrie Lecture

THE THEATRE AND BALLET IN CANADA. *Robert Speaight* (29th May)

Henry Morley Lecture

RECENT DEVELOPMENTS IN TRADE AND INDUSTRY IN PAKISTAN. *His Excellency Mr. Mohammed Ikramullah* (page 501)

Papers

THE GEZIRA SCHEME *Arthur Gaitskell* (page 67)

AN ACCOUNT OF THE RECENT COMMONWEALTH TOUR. *Lord Home* (Joint Meeting with the East India Association and the Pakistan Society) (page 191)

SOME SOCIAL EFFECTS OF TROPICAL MEDICINE WITHIN THE COMMONWEALTH. *Dr. R. S. F. Hennessey* (page 332)

RECENT DEVELOPMENTS IN THE FEDERATION OF RHODESIA AND NYASALAND. *Sir Gilbert Rennie* (page 399)

THE SNOWY MOUNTAINS SCHEME. *C. M. Gray* (26th April)

C. CANTOR LECTURES

The following courses were delivered during last Session:

THE SCIENCE OF BREWING. *Dr. A. H. Cook* (page 243)

MODERN WELDING. *Dr. H. G. Taylor* (16th, 23rd, 30th April)

SOME RECENT STUDIES OF SOCIOLOGY:

Class Conflict and Social Mobility. *Professor T. S. Simey* (7th May).

Some Aspects of the Development of Demography. *Professor David V. Glass* (14th May)

Changes in Social Responsibilities. *Dr. Roger F. Tredgold* (28th May)

D. DR. MANN JUVENILE LECTURES

Two Juvenile Lectures were given during the Christmas holidays as follows:

CLOCKS AND WATCHES—HOW THEY WORK. *A. W. Marshall* (page 322)

THE HISTORY OF THE CIRCUS. *Antony D. Hippisley Coxe* (page 414)

XXXII. MEDALS FOR PAPERS

The Council have awarded Silver Medals for the Session 1955-1956 to the following lecturers:

For Papers read at Ordinary Meetings

Professor Henry-Russell Hitchcock. 'Latin American Architecture'
Dr. W. F. Bewley. 'The British Glasshouse Industry'
Dr Cyril Bibby. 'T. H. Huxley and Technical Education'

For Papers read at Meetings of the Commonwealth Section

Arthur Gaitskell. 'The Gezira Scheme'
C. M. Gray. 'The Snowy Mountains Scheme'

Before moving the adoption of the Annual Report the Chairman spoke of the wide field of activity covered by the Society He drew particular attention to the personal and active part which the President played in its work, and to the institution of the Benjamin Franklin Medal.

The adoption of the Report having then been formally moved by the Chairman and formally seconded by Sir Edward Crowe, the Chairman invited questions upon it.

MISS VIOLET PAIN: What is the position about the assessment on this building?

THE SECRETARY: Under the provisions of the recent act, for the next few years at any rate our assessment is so raised that in effect the amount of rates payable will be the same as they were last year.

THE CHAIRMAN: We have also appealed, unsuccessfully, to the rating authority to exercise its discretion under the recent Act to remit our rates, and at the same time we are taking steps to claim exemption under the Act of 1843 dealing with the rating of the scientific societies.

The motion that the Annual Report should be adopted was then put to the meeting and carried unanimously.

The Chairman then called on Mr. P. A. Le Neve Foster, the Senior Treasurer, to move the adoption of the Accounts for the year ending 31*st December*, 1955.

MR. LE NEVE FOSTER: The Financial Statements have been published in the *Journal* and you will have seen from the report that we have got a surplus of income over expenditure of £3,862 and that this is rather larger than the surplus we had the previous year when it was £2,274.

I do not think you would want me to burden you with a lot of details about the accounts, but if you look at the Income and Expenditure account you will see that though our income has increased, the cost of running the Society has also increased. During a period of rising costs this is, I think, inevitable. On the other hand I think that the fact that the Accounts do show a surplus at a time when the cost of administering the Society is increasing does indicate that the Society's finances are in a healthy state and I would like formally to move the adoption of the Accounts.

Mr. H. G. Lowder having formally seconded their adoption, the motion that the Accounts be adopted was put to the meeting and carried unanimously.

The list of nominations having been exhibited in the Library in accordance with the Bye-Laws, and no additional nominations having been made, the Chairman called on the Secretary to announce the new Council for 1956–1957, *which was done as follows (names in italics are of Fellows who have not served on the previous Council)*:

PRESIDENT

His Royal Highness The Duke of Edinburgh, K.G.

VICE-PRESIDENTS

Sir Edward Crowe, K.C.M.G.
Sir Ernest Goodale, C.B.E., M.C.
Robert W. Holland, O.B.E., M.A., M.Sc., LL.D.
Sir Harry Lindsay, K.C.I.E., C.B.E.
The Earl of Radnor, K.C.V.O.
E. Munro Runtz, F.R.I.C.S.
Milner Gray (*Master of the Faculty of Royal Designers for Industry*).

ORDINARY MEMBERS OF COUNCIL

W. Greenhouse Allt, D.Mus., F.R.C.O., F.T.C.L.
Mrs. Mary Adams, O.B.E., M.Sc.
Professor Sir Henry Cohen, M.D., F.R.C.P.
Professor Sir Charles Dodds, M.V.O., M.D., F.R.C.P., F.R.S.
Robin Darwin, C.B.E., Hon.A.R.C.A.
John Gloag, Hon.A.R.I.B.A.
Sir William Halcrow, M.I.C.E., M.I.Mech.E.
The Earl of Halsbury, F.R.I.C., F.Inst.P.
A. C. Hartley, C.B.E., B.Sc., F.C.G.I., M.I.C.E., M.I.Mech.E.
William Johnstone, O.B.E., D.A.
Lord Latham, J.P.
F. A. Mercer, Hon.F.S.I.A.
Oswald P. Milne, J.P., F.R.I.B.A.
Lord Nathan, P.C., T.D., D.L., J.P., F.S.A.
Sir William Ogg, M.A., Ph.D., LL.D.
Sir Harold Saunders, F.C.G.I., B.Sc.(Eng.).
Sir Selwyn Selwyn-Clarke, K.B.E., C.M.G., M.C., M.D., F.R.C.P.
Sir John Simonsen, D.Sc., F.R.I.C., F.R.S.
Professor L. Dudley Stamp, C.B.E., D.Lit., D.Sc.
Sir Stephen Tallents, K.C.M.G., C.B., C.B.E.
G. E. Tonge.
Barnes Neville Wallis, C.B.E., D.Sc., R.D.I., F.R.S.
Sir Griffith Williams, K.B.E., C.B.
Miss Anna Zinkeisen, R.O.I., R.D.I.

TREASURERS

Sir Alfred Bossom, Bart., LL.D., J.P., F.R.I.B.A., M.P.
P. A. Le Neve Foster.

THE CHAIRMAN: I would like to interpose here, particularly as the last two names mentioned were those of our Treasurers. It has occurred to me in the course of this meeting that we do not really give expression publicly to our appreciation of the work which our Treasurers do for the Society. Mr. Peter Le Neve Foster has said that the Accounts are in a healthy state and I think that is true, and it is very largely due to the work which our Treasurers do. It is quite often true that the post of Honorary Treasurer is very much of a sinecure, but I can assure you that in this Society the Treasurers do really address their minds to the financial affairs of the Society and I think it is for that reason that those are in such good shape. I would like to propose to the meeting that we do here and now pass a very hearty vote of thanks to Mr. Peter Le Neve Foster and to Sir Alfred Bossom for their work as Treasurers of the Society.

The vote of thanks was carried unanimously.

THE CHAIRMAN: I also want to claim the privilege of proposing a motion that is an annual event, but it is nevertheless an important one and a sincere one: that is, a vote of thanks to the staff for their work during the past year. There has been no Bicentenary or other celebration in the year which has highlighted the work of the staff, but that does not mean that they have not been just as busy as in previous years. There has been a ceaseless round of activity: we had the Medals Exhibition and the Bursaries Exhibition and so on, and I can assure you that the Secretary and his staff do work very hard. As regards the Examinations staff, there is the increase in the number of papers worked which obviously

throws an added burden on the staff, especially the senior staff and I am sure the members do really appreciate the devoted service that is paid to the work of the Society and to the Examinations by its staff. We hope that the pressure at the Examinations Department will be relieved a little bit by an adjustment of accommodation which is under consideration and that they will be able to do their work in more congenial surroundings. If my remarks are brief they are none the less sincere. I have much pleasure in proposing to you a very warm vote of thanks indeed to Mr. Luckhurst and to the whole of his staff for their work during the past 12 months.

The vote of thanks was carried unanimously.

THE SECRETARY: Mr. Chairman, I wish to express the thanks of myself and all members of the staff for the kind words in which you, Sir, have proposed this vote of thanks and for the very kind response of the audience. I do assure you that we are greatly encouraged by the many tokens of appreciation which we receive from the Council and from the Society. One token of the Council's appreciation has for a number of years been that they have very kindly given the staff a Christmas party, and I think I should mention that this year we had a change and instead of just having a party here the Council agreed to our going to the circus! I have amused myself by going back over past history and contemplating some of my predecessors taking a party of their colleagues on the staff to such a performance. William Shipley, I am sure, would greatly have enjoyed it because you may remember that he got the idea for founding the Society by standing at the horse fair at Northampton and gazing on the wonderful beasts that were displayed there. On the other hand, when I look up from time to time and see the stern face of Sir Henry Trueman Wood looking down on me, I find it difficult to picture him going top-hatted from the Athenæum to join the rest of the staff at the circus! But, to speak more seriously, may I take this opportunity of saying how much we are helped in the staff not merely by annual expressions of appreciation such as this, but also by the constant readiness of all members of Council to give us assistance in our work. I realized nothing more rapidly when I came to this Society than that: that the members of Council are our real friends and always seem ready to put everything else down in order to give us their help. It makes all the difference to our work, and whatever success there may be in our work is so largely due not merely to its formal direction by the Council but also to the friendly, personal advice of its members.

SIR FRANK BROWN then proposed a vote of thanks to the Chairman of Council, Dr. Holland, for his untiring efforts on behalf of the Society and to Sir Ernest Goodale for deputizing for him so ably at the meeting.

The vote of thanks was carried with acclamation, and the meeting then ended and tea was served in the Library.

THE DEBT OF CHEMISTRY TO MEDICINE

The Pope Memorial Lecture by

SIR CHARLES DODDS, M.V.O., M.D., D.Sc., F.R.C.P., F.R.S.,

Courtauld Professor of Biochemistry, University of London at Middlesex Hospital Medical School,
delivered to the Society on Wednesday, 7th March, 1956, with Sir Charles Hinshelwood, M.A., D.Sc., P.R.S., Dr. Lee's Professor of Chemistry, University of Oxford, in the Chair

THE CHAIRMAN: Medicine, as we all know, is partly an art and partly a science, and perhaps we are not all quite so familiar with the fact that although chemistry is partly a science, it is also largely an art. The relative proportions of art and science, both in chemistry and medicine, change with circumstance and the time in which we live. The mutual influence of the two is a matter of very great interest both to the historian of science and, of course, to anyone who is interested in the processes of scientific thought and discovery. That is one of the reasons why the lecture by Sir Charles Dodds this afternoon is a matter of very great importance and interest to many of us.

There are few people who are so well qualified as Sir Charles is to speak on the subject. He is a distinguished biochemist whose own work, especially in the field of hormones and related substances, could itself really form a basis for practically a whole lecture on this subject. I do not know, of course, how he is proposing to treat it, and I am looking forward to hearing that, but his work has been quite outstanding in this field.

The following lecture, which was illustrated by lantern slides, was then delivered:

THE LECTURE

Previous lectures have dealt with a number of aspects of Sir William Pope's life and scientific career, and Sir Robert Robinson, as chairman for the previous lecture, pointed out that most of the aspects of a biographical character have already been covered, and that Sir Alexander Todd was proposing to lecture on a subject in which he himself had been particularly interested, namely 'The Chemistry of Nucleic Acids'. I feel that I must follow this example, although perhaps I might add just a few remarks about the subject of these memorial lectures.

I have chosen a provocative title for this lecture and I think Sir William himself would have enjoyed the reversal of what is usually understood. It is common to speak of the debt of medicine to chemistry, and this indeed is very great, but I hope to be able to convince you, by the end of this lecture, that the reverse is also true. Sir William himself was very fond of provocative

arguments and I well remember on one occasion being present when he became engaged in an argument with Sir Almroth Wright, himself a very provocative person. Sir Almroth attacked Sir William on the grounds of his using his genius and chemical ability for warfare purposes and referred to the fearful intellectual responsibility that Sir William had for his work on mustard gas. Sir William immediately turned on Sir Almroth and pointed out that his contribution to war was very much more effective than his own. Prior to the introduction of the anti-typhoid vaccine it was impossible to keep an army of more than about 100,000 men in the field, because if this figure were exceeded the rate of typhoid carriers rose sufficiently to give a continuous series of epidemics with the result often that the army lost its striking force. Owing however to Sir Almroth's brilliant discovery of the protective effects of the T.A.B. vaccine, armies of any size were able to be present in the field, and I saw Sir Almroth for once in his life without a ready answer. Those who remember Sir William in his later years will recall that he suffered from a very severe nervous affection which produced a rigidity of the neck muscles. This caused him great pain and discomfort which he bore with great fortitude. Whenever any new medical appointment was made in the University of Cambridge, it was always a set ritual that they tried to cure Sir William's affliction and he submitted to this, again with philosophic resignation. On one occasion the medical man then in the saddle decided that Sir William should see a psychiatrist, and again he meekly agreed to do this. I shall always remember waiting for him at lunch after he had been to his first consultation. Apparently the psychiatrist gave him a mirror and told him to hold it out at arms' length and look into it. This he did, and the psychiatrist, after a time, asked what was passing through his mind. Sir William replied that his arm was aching and that if he could only put the mirror on the mantlepiece he thought it would be better. The psychiatrist then decided that he could go no further with this obviously psychiatric-resistant case.

The early history of chemistry is very closely tied up with that of medicine, as most of the chemists obtained their inspiration from pharmacy and from a study of drugs of natural origin. Many of the mediæval chemists actually practised some form of medicine. The first half of the last century was devoted mainly to studying the constitution of many of the naturally occurring substances of which drugs predominated, and the latter half of the century was devoted mainly to the synthesis of these naturally occurring substances. With the extension of the science of synthetic organic chemistry, it became obvious that it was possible to produce substances other than those that existed on the surface of the earth, and the science of what one might term 'pure' or theoretical synthetic organic chemistry was studied. In a way synthetic organic chemistry could be compared to mathematics which can be classified into pure and applied. Applied mathematics deal with the actual practical problems and would correspond to the synthesis in organic chemistry of substances in nature. Pure mathematics, on the other hand, deal with abstract questions unrelated to reality, and pure synthetic organic chemistry could be described as a synthesis of compounds merely for the sake of studying their properties and for the development of the

technique of synthesis. I hope to show in this lecture that the stimulus of some of the newly discovered substances in the animal body, and in the realm of microbiology, have stimulated the organic chemist to much greater efforts than I think his own imagination would ever have done. Therefore, I think that perhaps I shall have little difficulty in convincing you that medical science has indeed added a good deal to the subject of organic chemistry.

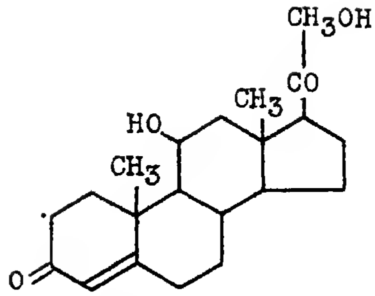
We might perhaps start with a consideration of the hormones. One would search a long time to find a better example of my thesis than in those interesting chemical substances secreted by the cortex of the suprarenal gland. In order to give you the complete picture it is necessary to go back almost exactly to 101 years ago when Thomas Addison, a physician at Guy's, published in the Guy's Hospital Report a paper which has become a medical classic. He described the post-mortem findings on a series of patients who presented the same clinical picture during life. Their symptoms consisted of extreme lassitude associated with pigmentation, wasting and gastrointestinal disturbances. The post-mortem findings showed a complete destruction of the two small glands situated at the end of the kidney and known in those days as suprarenal capsules. The cause of this destruction was practically always due to a tuberculous infection. The disease is now known as Addison's disease and with the growth of knowledge during the last hundred years we know that the symptoms are due to lack of an internal secretion or hormone produced by the suprarenal cortex. Removal of both of these bodies is always attended by death and therefore we can say that the suprarenal tissue is the only one in the body which is essential to life. When the endocrine mechanism was understood, it was only natural that chemists and biochemists should seek some form of extract of the gland which could be administered to patients with this disease. The search was not successful until 1930 and this was mainly due to the fact that there was no really accurate and clear-cut method of testing the extract. Whilst it is true that laboratory animals when adrenalectomized invariably die, it was not until the 1920s that administration of extracts to such animals was developed into a roughly quantitative method of standardization. The American workers Swingle and Pfiffner were the first to produce a stable active substance that could be administered to animals and human beings. This was an extract made from slaughter-house material and was of course of unknown constitution. It was capable of maintaining adrenalectomized animals in a state of health and was used successfully in the treatment of Addison's disease. This material answered all the clinical needs of the day and, but for certain new discoveries of which I will tell you shortly, would undoubtedly still be in use and satisfying the clinical needs for the treatment of adrenal insufficiency due to Addison's disease and other similar or allied conditions.

To develop my story we must now turn to another group of workers. The period between 1920 and 1930 saw very great chemical developments in our knowledge of the structure of cholesterol and allied substances, and by the 1930s the structure of cholesterol was agreed upon by all interested research workers. The recognition of a basic cyclopenteno phenanthrene ring system gave a very great stimulus to research in bodies which were thought to have properties

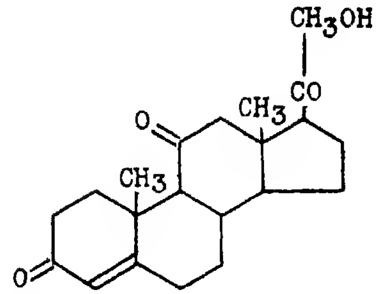
similar to the sterols. Very quickly the constitution of the sex hormones, oestrone, progesterone and testosterone were elucidated and they of course were all found to belong to this cyclopenteno phenanthrene ring system of compounds. In view of the lipoidal nature of the cortex of the suprarenals, a detailed study was undertaken of the substances present there and in the early 1930s a series of papers began to emanate from two laboratories, one in the Mayo Clinic, that of Professor E. C. Kendall, and the other one in Basle under Professor Reichstein. Both these workers pursued their investigations independently and they were able to show that the active principles of the suprarenal cortex also belonged to this cyclopenteno phenanthrene ring system of compounds. Some fifty substances have now been isolated and identified but the two most important are corticosterone and dehydrocorticosterone (see formulæ Figure 1). Both of these substances are capable of maintaining the adrenalectomized animal in good health and presumably would also be capable of controlling the symptoms of Addison's disease. It must be pointed out, however, that these substances have been isolated in minute quantities from literally tons of slaughter-house material and, therefore, are extremely valuable and only, at least at this stage, of theoretical interest.

Up to 1948, therefore, we have this position. From the clinical angle the physicians are entirely satisfied with the Swingle-Pfifner extract of unknown constitution, and the chemists having produced a series of compounds of apparent academic interest only. As I said earlier over fifty substances of the corticosterone type have been isolated from the suprarenal cortex and it is not proposed to go into the constitution of these substances, with one exception, and that is the substance which Kendall referred to as 'Compound E' (see formula Figure 1). This in effect, as can be seen from the formula, is corticosterone with an additional hydroxy group attached to the 17 carbon atom. Kendall isolated this substance from the suprarenal cortex obtained from slaughter-house material and obtained a few grammes of it. As he himself said afterwards, he had a kind of sentimental interest in this compound as the determination of its constitution had presented very great difficulties. Up to 1948 this substance was simply one of the fifty-odd compounds isolated from the suprarenal cortex and was of no practical significance.

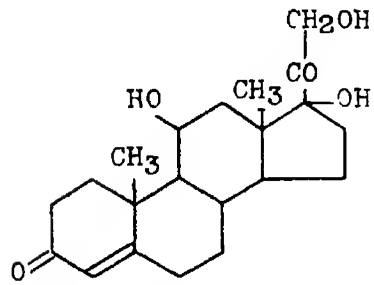
We must now turn to another group of workers, in this case clinicians. A team at the Mayo Clinic, under Dr. Hench, had been investigating the clinical history and nature of the disease rheumatoid arthritis. They had confirmed the old statement that a person with rheumatoid arthritis would experience a remission when certain intercurrent conditions or diseases supervened. Two of the most potent causes of remissions in this chronic rheumatoid arthritis were firstly an attack of jaundice, and secondly the incidence of pregnancy. Hench and his collaborators were able to show that if a patient with severe rheumatoid arthritis with limitation of movement of joints, pain and so forth, experienced a severe attack of obstructive jaundice there was an immediate improvement in the symptoms of the condition; thus joints which had been either immovable or had been very restricted became much freer, pain largely disappeared. When, however, the jaundice was relieved it was noted that the condition returned



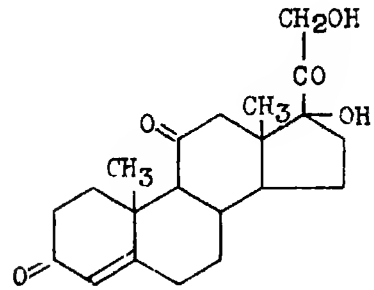
Corticosterone.



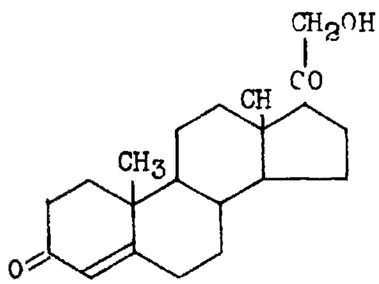
Dehydrocorticosterone.



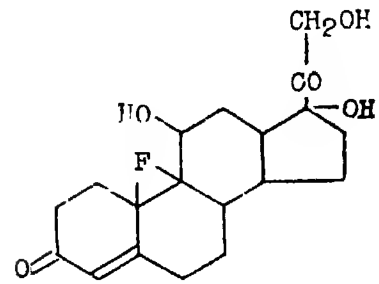
Cortisone, 'Compound E'



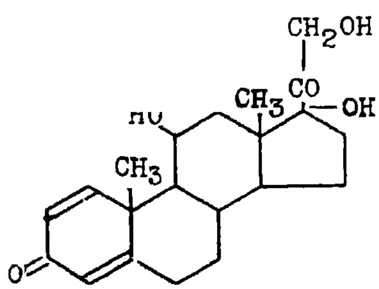
Dehydrocortisone.



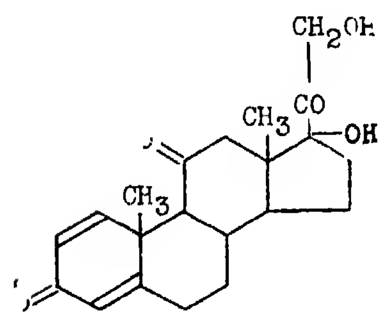
Dehydroxycorticosterone



9 a fluoro cortisone



Prednisone



Prednisolone

FIGURE 1

with its full previous severity. The result of a woman with severe rheumatoid arthritis becoming pregnant was even more striking. Within a very short while the pains of rheumatoid arthritis, restriction and limitation of movements, were either greatly improved or symptoms practically disappeared. This continued throughout the whole pregnancy and remained for two to three days after delivery of the child. When delivery had occurred, however, a rapid return of the symptoms resulted and by the end of the week after delivery the patient's rheumatoid condition was just as bad as before the pregnancy.

Hench naturally tried to connect these two conditions and sought for a common factor. We know that in jaundice there is reabsorption of the bile including its cholesterol and bile salts, and these circulate freely in the blood and diffuse into all the body fluids. We also know in the case of pregnancy that the whole body is saturated with oestrogens. In most animals these are excreted in the urine in large quantities and it is well known that the urine of the pregnant mare was used as a commercial source of oestrone for many years. The pregnant woman secretes large quantities of oestriol in her urine throughout the whole of pregnancy and it is possible to identify this and other oestrogenic hormones in the blood and other body tissues. Here Hench thought was the connecting link and the substance which is produced in the remission may be of a steroidal character. He then started to try all the known steroidal substances upon which he could lay his hands; cholesterol and a number of phyto sterols were investigated as were the sex hormones both male and female and progestational. The results were uniformly negative. He then turned to the question of the suprarenal cortex, the only other tissue to produce steroidal hormones. He tried the Swingle-Pfifner extract and this was valueless, having no effect at all, and had to be added to the list of inactive compounds already mentioned. Discussing the matter with Professor Kendall he decided to try this 17-hydroxy compound, or 'Compound E' as Kendall had described it. As this material was made from slaughter-house glands and the yields were small they only had a very limited amount of material and therefore decided to limit their injections to a hundred milligrammes. All of you will remember the great sensation that the announcemnt in 1948 and 1949 made on the medical and general public. Hench described his researches in very great detail with almost quantitative data on his cases. These researches showed that after three injections of a hundred milligrammes per day of 'Compound E' a miraculous reversal of the symptoms of rheumatoid arthritis occurred. The remission was very nearly as good as that obtained in pregnancy and was on the whole better than that appearing in jaundice. Joints that could not move previously became freely movable, pain diminished or was abolished, and above all the patient experienced a feeling of well-being or euphoria which is very striking indeed. Unfortunately, if the administration of the substance was interrupted all the symptoms returned and the euphoria disappeared and the patient was in a condition even a little bit worse than he started. The great interest from the medical point of view in these investigations was a demonstration that the rheumatoid arthritic process was a reversible one. The old observations on the remissions caused by jaundice and pregnancy had been

forgotten until they were revived by Hench and the medical profession was faced with what appeared to be an entirely new situation, namely the reversal of a pathological process which had hitherto been regarded as irreversible and continuously progressive. The dilemma of the medical profession can well be imagined. Here was an apparent method of almost curing, or at least greatly improving, this very distressing condition, which is responsible for the greatest loss of man-hours in industry, yet the material, 'Compound E' is so scarce as to be literally unobtainable. I should doubt if organic chemistry has ever been presented with a more interesting, and at the same time more difficult, problem than the production of 'Compound E' or cortisone as we now know it.

To solve this problem required all the ingenuity and chemical erudition of the experts in this field. The total synthesis of a substance like cortisone on a commercial scale, certainly at that time, was out of the question. Not only would the synthesis present the greatest difficulties from a purely structural point of view, but the problems and difficulties brought in through stereoisomerism are too formidable even to be contemplated.

The introduction of a ketone or hydroxyl group in position 11 of the steroidal hormones again is not possible, as no technique is known whereby this could be done. It is interesting at this point to note that practically all the sex hormones are prepared now by a partial synthesis from cholesterol which has previously been degraded by treatment with chromic acid. This oxidizes off the side-chain attached to the 17-position and leaves a substance, dehydro-iso-androsterone, which can be used as the starting point for the synthesis of any of the known sex hormones. It is possible to make a substance very similar to cortisone and corticosterone using this substance as a starting point. This is known as dehydroxycorticosterone or DOCA (see formula Figure 1). This possesses some of the properties of corticosterone and is particularly valuable for its powers of retaining electrolytes in the human body. It will, however, not completely replace these substances and when tested for an anti-rheumatic effect was found to be completely inactive.One would have thought that it ought to be possible to produce cortisone, or corticosterone, from this substance but as I have already pointed out there is no known method of introducing a hydroxyl or ketone group in the 11-position by chemical means.

The problem was eventually solved by starting with deoxycholic acid, a substance obtained from slaughter-house bile. Amongst other groupings this possesses a hydroxyl group in the 12-position and by brilliant synthetic methods it is possible to move this from the 12 to the 11 position and also to build the rest of the molecule so that cortisone results. This process, which takes over thirty stages, is the one by which cortisone was produced until comparatively recently. This surely must represent one of the greatest triumphs of organic chemistry. To undertake this production, even on a laboratory scale, ten years ago would have been regarded as little short of miraculous, but to adopt the processes of a research laboratory to the works and operate a complicated process like this on a tonnage basis, must as I say be the greatest triumph of chemistry applied to the fine chemical pharmaceutical industry.

The demonstration of the anti-rheumatic qualities of cortisone led to an intensive research into other starting materials for the synthesis and we now have a number of new ones apart from deoxycholic acid. One that is used extensively in this country is a sterol present in sisal waste, namely hecogenin. This substance can be obtained from parts of the British Commonwealth and, therefore, avoids the necessity for dollar expenditure, and it is a cheaper starting material, even apart from this consideration, than deoxycholic acid.

The need for cortisone has produced some very striking changes and developments in the production of steroidal substances. One of the most interesting is the entry of the microbiologist into this field. Up till the time when there was this demand for cortisone it was thought that the sterols were the exclusive perquisite of the synthetic organic chemist, but the microbiologist has broken into his stronghold and produced some very remarkable results. Peterson, of America, has succeeded in producing cortisone from progesterone, which can be produced in large quantities and cheaply, from plant sources. The micro-organisms that induce these strange changes are moulds and it is possible to produce moulds that will hydroxylate progesterone in the three positions necessary to give cortisone. This method is now in use as an alternative to the very elaborate synthesis which has already been mentioned. I am sure you will agree that it is very doubtful if the organic chemist, and certainly sure that the microbiologist, would never have entered this field, but for the interest created by the clinical observers.

The organic chemist, not content with producing cortisone, has introduced a number of variants which are proving to be of interest from the clinical point of view. Cortisone and dehydrocortisone (see formulæ Figure 1) are now used extensively in the treatment of a number of conditions known as the collagen diseases. These include rheumatoid arthritis and the hitherto fatal condition known as *lupus erythematosus diffusus*. Two other new compounds are at present receiving very great attention from the clinicians, and these are known as prednisone and prednisolone (see formulæ Figure 1) and correspond with cortisone and dehydrocortisone but that they have in addition an extra double bond in ring A. These substances are stated to be many times more active than cortisone and doses of a very few milligrammes are said to be able to keep the patient under control Another fascinating development is a series of compounds with a fluorine atom in the 9α-position. 9α-fluoro-cortisone (see formula Figure 1) has received a good deal of clinical attention, but it is no use in the treatment of rheumatoid arthritis as it causes salt retention to a dangerous degree when given in large quantities It is, however, of great use in the treatment of certain conditions such as Addison's disease, acute adrenal insufficiency and so forth.

Another very good example can be quoted from the work of my colleagues, Mrs. Simpson and Dr. Tait. After having established a new method of testing steroids for their salt retaining qualities, they applied the method to an investigation of the Swingle-Pfifner extract. After a brilliant series of experiments they were able to produce evidence that indicated that there was in this extract a mineralocorticoid much more powerful than anything hitherto known. By its

behaviour on chromatographic studies they were able to convince themselves that this substance was an entirely new one. They were able to isolate it in a pure form and it was called 'Electrocortin' (later called 'Aldosterone'). Later, together with Professor Reichstein and his colleagues, they were able to identify its constitution and this is shown in Figure 2.

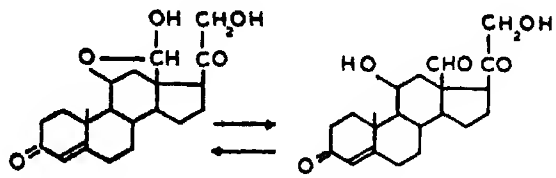


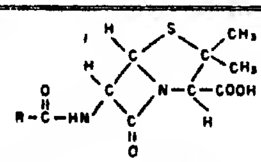
FIGURE 2. *Aldosterone*

One might point out that this is an entirely new departure in the formula of compounds of this type and is the first occasion where the angle methyl group between ring C and D has been shown to be modified. One form with the oxygen bridge to the 11-position is particularly interesting. This opens up a new series of possibilities of steroids of this type of configuration and surely again this could never have been evolved without the primary biological observation.

We can, therefore, see that the original medical observation has caused a very great deal of pure chemical research resulting in the great increase of knowledge purely from the chemical point of view. It is, of course, not the purpose of this lecture to discuss the medical aspects solely and it is advisable to point out that whilst these cortisone-like substances possess very great beneficial qualities, they also are double-edged weapons and, if used indiscriminately, can do a great deal of harm. We do not really understand how they produce their effect, but we know that this is beneficial in a number of clinical conditions and, when they are used with caution and care, they make a good contribution to the alleviation of human suffering. It would be possible to give many more examples than the hormone field, but I should like to turn from this to another extremely fascinating development of recent years which, whilst giving entirely new weapons to combat disease to the medical man, have provided the chemist with a new series of compounds which, I feel sure you will agree, could never have been conjured up out of any purely theoretical or pure approach *via* synthetic organic chemistry.

I would like to take as my next example the antibiotics, of which we may start with penicillin. The history of the discovery of penicillin is so well known that we need only refer to it in general. Sir Alexander Fleming observed in 1929 the astonishing fact that, when a mould dropped on one of his cultures in a petri dish, as the mould developed so the bacteria in the immediate surrounding disappeared, and he came to the conclusion that the mould produced a substance which actually killed the bacteria and he suggested the name of penicillin. He was able to show that this substance could be extracted from the mould and that

it was capable of killing bacteria in vitro. He suggested that the substance would certainly be useful in the classification of bacteria as it only killed certain types and might possibly be of use in the application to superficial wounds. From 1929 onwards a number of workers tried to produce the substance in a pure form, or in any case in such a state that it could be used. Time does not permit our reviewing many of the gallant attempts which failed and we must proceed to the first successful research which was conducted by Sir Howard Florey in his Oxford Laboratories. Florey and his colleagues Heatley and Chain were able to produce sufficient material to show that when injected into infected animals complete protection could be obtained. With great difficulty they succeeded in making enough to treat a few cases of human bacterial infection and showed again that the substance was highly effective.



AMERICAN COMMON NAME	BRITISH COMMON NAME	CHEMICAL NAME	R GROUP
Penicillin G	Penicillin II	Benzylpenicillin	$-CH_2-$
Penicillin K	Penicillin IV	n-Heptylpenicillin	$CH_3(CH_2)_5CH_2-$
Penicillin X	Penicillin III	p-Hydroxybenzyl-penicillin	$HO-\quad-CH_2-$
Penicillin F	Penicillin I	2-Pentenylpenicillin	$CH_3CH_2CH=CH-CH_2-$
Dihydro-penicillin F	Dihydro-penicillin I	n-Amylpenicillin	$CH_3(CH_2)_3CH_2-$

FIGURE 3. *Penicillin (Doerge, R.F., 1954,* Text-book of Organic, Medicinal and Pharmaceutical Chemistry, *2nd Ed., J. B. Lippincott Co.)*

From these observations developed the great fermentation industry of America and this country where penicillin is produced in great quantities and is now a universal remedy for general and local infections. The introduction of penicillin has completely changed the whole face of medicine. Diseases which were hitherto regarded as incurable are now dismissed by a few injections of this substance and diseases such as pneumonia and the venereal diseases, which are a scourge to humanity, have literally been relegated almost to footnotes in textbooks of medicine. The social implications of penicillin and the whole of the antibiotic series of remedies are very great indeed. There is no doubt that the whole structure of society will be altered by these important drugs, because of the fact that they eliminate many of the killing diseases. For example respiratory diseases, such as pneumonia, bronchitis and so on, were very high up in the list of killers and the virtual elimination of these has greatly increased the expectation of life so that to-day one can see already the effects of prolonging life. This is resulting in the accumulation of more and more people at the latter end of the span of life and it can be calculated that in the future the population will be overburdened with elderly people who presumably will depend on the younger for their support.

Great and interesting as is the medical and bacteriological interest in this substance, penicillin, which despite its great potency is practically without toxic effects, its chemistry is perhaps even more fascinating. The constitution is shown in Figure 3 and represents an entirely new type of organic compound. I think it is fair to assume that no amount of pure speculation even of the most imaginative of the organic chemists could have evolved such a structure. Even more elaborate is the compound, streptomycin and its derivative, aureomycin, whose structures are shown in Figures 4 and 5. Again, these represent an entirely new type of organic compound and they have been obtained through the study of organisms obtained from soil. These organisms are of the streptomyces variety and they produce an infinite number of compounds of the streptomycin type. Again, another interesting compound was revealed in the study of the antibiotic, chloromycetin, or chloramphenicol. This substance, whose formula is shown in Figure 6, is the first one in nature in which a para-nitro group has been found attached to a benzene ring. From the medical standpoint chloromycetin is of the greatest interest because unlike the other antibiotics it attacks infective agents which are approaching the size of viruses. It is shown that chloromycetin may cure the ricketsia type of infection of which various forms of typhus are the best known. This is of the very greatest interest from the medical point of view and has succeeded in changing the conditions of many places in the tropics which hitherto were considered extremely dangerous from the point of view of typhus infection.

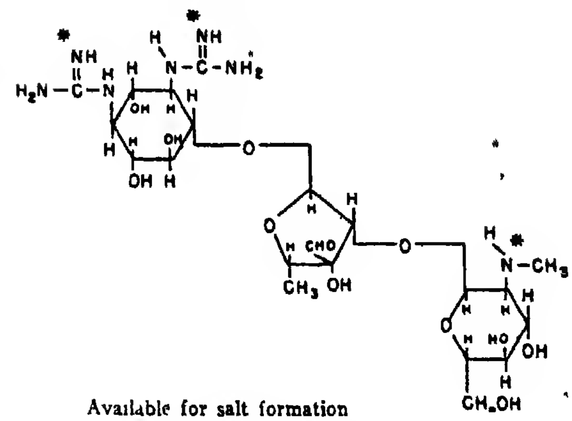


FIGURE 4. *Streptomycin*

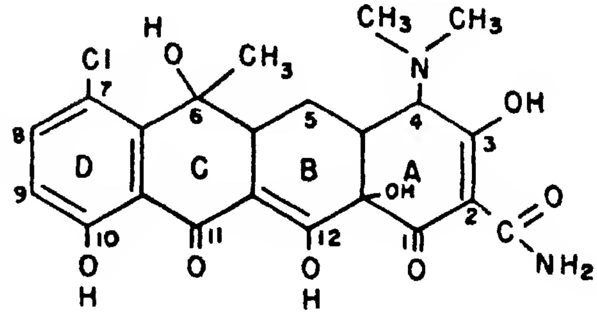


FIGURE 5. *Aureomycin*

Again it is possible to turn to another series of examples which are provided by a study of the chemistry of the vitamins. For example, Vitamin A represents a type of compound in which the chemists have shown little interest and the same applies certainly to Vitamins B_1 and B_2. One of the most interesting examples that one can quote is the recent work on Vitamin B_{12} (Figure 7). Again, I think

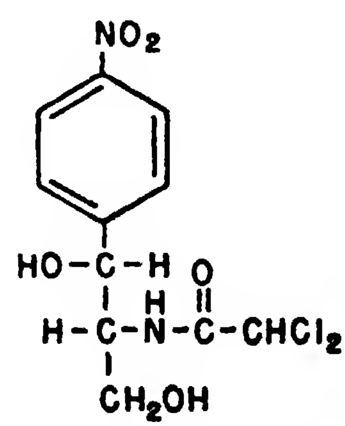


FIGURE 6. *Chloromycetin*

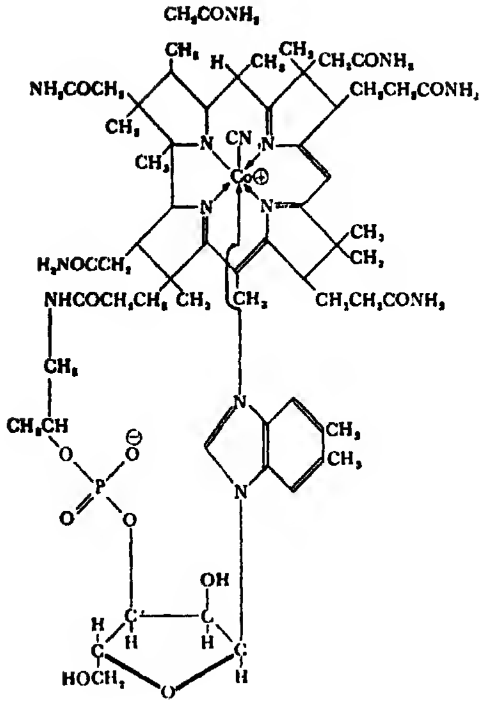


FIGURE 7. *Vitamin B_{12} (From* Endeavour, *Jan. 1956. Johnson, A. W. and Todd, A.)*

I am right in saying that the organic chemist had very little interest in organic compounds containing cobalt, and again I doubt very much whether even the most erudite would have thought of making a substance with anything like the complexity of formula as that of Vitamin B_{12} of which the latest series of extraction is shown in Figure 7.

This substance has proved of the greatest interest not only in human blood disease and nutritional disorders but in those of animals and a study of its activity goes a long way to explain the importance of trace elements in animal feeding.

In conclusion I hope that my examples will have convinced you that chemistry does owe a great deal to the biological sciences and particularly to medicine. Many more examples than those quoted above could be given. Everything seems to indicate in the future that more and more new substances will be found in nature and it is highly probable that many new forms of structure will be demonstrated to provide the organic chemist with further material on which he can exercise his art. Fortunately, to-day there is a close co-operation between medicine, biochemistry and organic chemistry, and if we take only the examples that have been quoted to-day as specimens of what this collaboration can offer, we can well see that a continuation of this in the future will surely pay handsome dividends.

The situation can perhaps be rather neatly summarized by a remark attributed to Professor Kendall, the discoverer of cortisone. On remarking upon the value of co-operation between medicine and chemistry he is reputed to have said that whereas he had taught Dr. Hench to say '17-hydroxy-11-dehydrocorticosterone', on the other hand Dr. Hench had taught him, a chemist, to say '*lupus erythematosus diffusus*'.

THE CHAIRMAN: I think everyone will agree that Sir Charles Dodds has given us a most masterly account of what must be one of the most wonderful stories of modern times. His thesis that chemistry owes a good deal to medicine is not one which the chemists find very provocative, but one which commands quite ready assent.

Sir Charles began by telling us some stories about W. H. Perkin, Jnr. On one occasion, Perkin examined a thesis about synthetic organic chemistry and beaming at the candidate said, 'I see, Mr. X., that you have prepared 24 new compounds'. The young man, looking rather pleased, said that he had, and Perkin went on, 'What on earth did you do it for?' In fact, the reasons for making these substances had not been at all clear. Over a hundred thousand compounds are known to organic chemistry

and there is no reason to suppose that there is any limit to the possible number. The principle of selection offered by the requirements of medicine is a most valuable one and organic chemistry would be the poorer if it did not exist. Nature, after all, is cleverer than man and, as Sir Charles has shown us, many of the clues provided by natural products could not possibly have been dispensed with. On the other hand, I am sure Sir Charles will agree—indeed his whole lecture made it clear that he does—that the organic chemist has accepted the challenge in a way which is itself also a wonderful story.

I shall not put to the vote the thesis that organic chemistry has owed much to medicine. I am sure it would be carried unanimously. What I shall do instead is to propose a hearty vote of thanks to Sir Charles Dodds for his most stimulating and valuable lecture.

The vote of thanks to the Lecturer was carried with acclamation.

DR. R. W. HOLLAND, O.B.E., M.A., M.SC. (Chairman of Council of the Society): As a very old student of W. H. Perkin, Jnr., I have a very pleasant duty to perform in proposing a vote of thanks to our chairman this afternoon.

It is a somewhat strange position for a Professor of Chemistry at Oxford to be gracing the chair this afternoon at a lecture founded in memory of a Professor of Chemistry at Cambridge, but when the occupant of the chair at Oxford comes to the position of President of the Royal Society he must necessarily throw off any question of bias, and hold the balance evenly, as he has done this afternoon in so kindly acting as chairman for Sir Charles. I ask you to give to him your very sincere thanks for the way in which he has conducted the business.

A vote of thanks to the Chairman was carried with acclamation, and the meeting then ended.

GENERAL NOTES

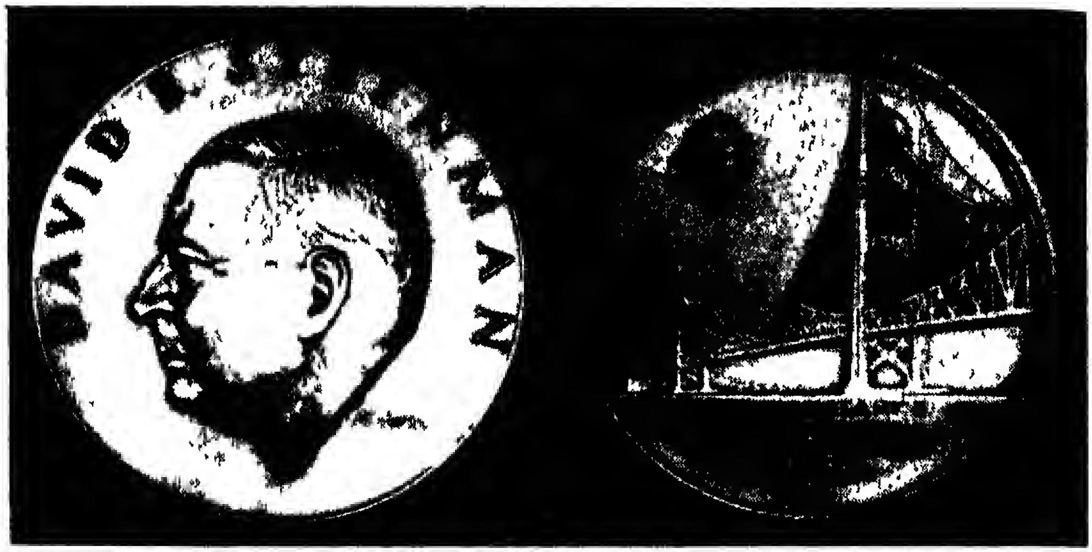
THE DUKE OF EDINBURGH'S STUDY CONFERENCE

A conference, initiated and opened by His Royal Highness the Duke of Edinburgh, is at present being held at Oxford to discuss the human problems of industrial communities within the Commonwealth and Empire. The conference members, of which there are some 300, are young men and women of proved ability from both sides of industry and from all parts of the Commonwealth. They are not representing any organizations and no formal conclusions are expected to result from their deliberations, which will, it is hoped, result in a wider understanding of this complex subject.

The Duke of Edinburgh, in his opening speech on 9th July, referred to the 'four basic ideas at the back of this conference'. Firstly, they had to decide whether lessons from the past could help in overcoming the problems of present industrialization, and secondly, could the new industries of the Commonwealth help each other. Thirdly, conclusions might be formed about factors contributing to a good works, a happy community and a satisfied individual. The final point concerned the 'bewildering variety of shapes' which the simplest industrial problems assumed when viewed from the various standpoints of an industry.

The Conference members are divided into study groups of 15 persons, with people from different parts of the world mixed in each. The conference began with lectures on industrial problems, these being followed by visits to industry and final discussions of the impressions gained.

GIFT OF MEDAL TO THE SOCIETY



A bronze replica of the medal reproduced above has been presented to the Society by the Professional Engineers of France, at the request of Dr. D. B. Steinman, one of its Fellows, in whose honour the medal was struck and to whom it was initially awarded in gold; a bronze replica will be struck annually for award by the Professional Engineers of France. The medal is the work of Professor A. F. d'Andrea, also a Fellow of the Society and Head of the Art Department of the City College of New York.

The reverse of the medal bears Dr. Steinman's design for the proposed Messina Straits Bridge, a five thousand foot main span to connect Sicily to the mainland of Italy.

GLASS DESIGN EXHIBITION

An Exhibition of designs in glass, entitled 'Glass and the Student Designer', by students of the Royal College of Art, Edinburgh College of Art, and Stourbridge College of Further Education, is on view at the headquarters of the Glass Manufacturers Federation, 19 Portland Place, London, W.1, where it will remain until 27th July. The Exhibition is open from 10 a.m. to 4 p.m. on Mondays to Fridays, and 10 a.m. to 12 noon on Saturdays. Admission is free

COLOUR PRINTS EXHIBITION

With the object of raising the standard of print making and the status of the graphic arts in this country a group of artists have formed themselves into the New Editions Group. The first Exhibition of their work, including lithographs, lino-cuts and etchings, is now on view at the Zwemmer Gallery, 26 Lichfield Street, W.C.2, where it will remain until 15th August. Only a limited number of prints, produced by the artist himself, is made from each design. The Exhibition is open from 10 a.m. to 6 p.m. on Mondays to Fridays and from 10 a.m. to 1 p.m. on Saturdays. Admission is free.

SOUTH AFRICAN PAINTINGS EXHIBITION

An Exhibition of South African paintings by Mr. Walter Battiss, Principal of the Arts Centre, Pretoria, and a Fellow of the Society, is at present on view at the Imperial Institute Gallery, South Kensington, where it will remain until 29th July The Exhibition, which comprises about fifty extremely original and interesting adaptations of the virile art of the Bushman, is open from 10 a.m. to 4.30 p.m. on Mondays to Fridays, 10 a.m. to 5 p.m. on Saturdays, and 2.30 p.m. to 6 p.m. on Sundays. Admission is free.

OBITUARY

PERCY A. WELLS

We record with regret the death, in London on 6th July, of Mr. Percy A. Wells, at the age of 88.

Percy Wells, who was Principal of the Shoreditch Technical Institute for some thirty years until his retirement in 1933, was of the old school of furniture craftsmen. He did much to maintain the high standard of furniture making in this country, and was made the first Honorary Freeman of the Furniture Makers' Guild for his great services to the trade.

In 1909 he read a paper on 'English Furniture' before the Society, for which he was awarded a Silver Medal. He took a keen and active interest in the Furniture Section of the Competition of Industrial Designs held from 1924 to 1933, and had written a number of books on cabinet making.

Mr Wells was elected a Fellow of the Society in 1909.

NOTES ON BOOKS

THE PENROSE ANNUAL, 1956. *Ed. by R. B. Fishenden. Lund Humphries,* 35*s*

This is the fiftieth issue of the *Penrose Annual* and the twenty-first year of the present editor's tenure of office. The jubilee is celebrated modestly, but the majority goes unsung; yet Penrose is to-day what its present editor has made it. When Mr. Fishenden was appointed in 1935, the pattern of the annual had been already projected but he has given it form and purpose and consistently high quality.

The general plan is now familiar. A series of articles on design comes first, with a far-reaching review by the editor; then follow a group of technical articles, next the 'illustrations of the year', and finally advertisements. The outline is filled in by the editor and given aim and balance.

Penrose began in 1895 as a purely technical yearbook for the process trade. It was not until Lund Humphries became the proprietors that it began to appeal to a wider field, and to contain articles on design. Since Mr. Fishenden became the editor it has also become itself an interesting example of design, different each year.

In the general articles there is an undercurrent of emphasis upon the unity of art, implied in articles on the illustrations of William Nicholson and E. McKnight Kauffer, and clear in Charles Rosner's article on the indivisibility of art. The theme is pursued further in a pretentiously written review of American graphic art. Beatrice Warde's lively discourse on the meaning of words and typographic legibility is a relief from this, and an example of how to write to be read.

A handful of articles on type and lettering drive home the truth that a good letter is a legible letter and something more. John Dreyfus discusses, among other scripts, the astonishingly effective Mistral, and Vivian Ridler considers, without enthusiasm, the merits of Linotype's Minerva.

The technical articles in *Penrose* always have a forward emphasis; if there is a new invention of promise, *Penrose* will have an article on it. The bias is still towards process work, or one of the many variations upon it—lithography, gravure, auto-screen plates, the Scan-a-sizer, and so on. Photo-composition, which used to occupy our thoughts so much, is represented this year only by an article on a machine for setting Chinese.

At the end of *Penrose* comes what is one of the most purely enjoyable of its features, the 'illustrations of the year'. This is a heterogeneous picture book which provides me with the childish pleasure of turning page after page to find each time something rich and strange and quite inconsequent. After this come the trade advertisements,

many of which fall dismally short of the standards of taste and design which are typical of *Penrose.*

The jubilee issue is certainly one of the best issues of recent years; and, as the *Penrose Annual* has always been, it is, physically and æsthetically, remarkable value for money.

SEÁN JENNETT

SHORT NOTES ON OTHER BOOKS

THE GRASS ROOTS OF ART. *By Herbert Reed. Faber,* 1955. 18*s*

An analysis of some of the factors which have accounted for great periods of art in the past, and suggestions of the changes which would be necessary to make our industrial age more conscious of creative values, form the theme of these lectures on the social aspects of art. There are 36 photographic illustrations in this revized edition of the book first published in New York in 1946.

NEW HORIZONS IN COLOUR. *By Faber Birren. Reinhold,* 1955. 80*s*

Mr. Faber Birren in his book writes on the problems of the dynamics of seeing and of illumination, colour and form. Further chapters are devoted to the application of colour and lighting in public buildings including schools, hospitals, industrial plants, office buildings, hotels and so on. The desirability is stressed of limiting ranges of colours, particularly in the paint industry, for economic and maintenance reasons.

There are over 150 photographs, of which six are in full colour.

FROM THE JOURNAL OF 1856

VOLUME IV. *25th July,* 1856

From a report on a fête *held in connection with* The Wirksworth Mechanics' Institution.

Mr. Cantrell, as president, addressed the meeting upon the present condition and future prospects of the Institution. He characterised their position as a peculiarly happy one, and looked with hope for the future. The Rev. J. Edwards then proposed the following sentiments —'Prosperity to the Wirksworth Mechanics' Institution, and to all similar Societies, as the chief sources and most effective promoters of the intellectual cultivation of the people'.—The Rev. F. H. Brett cordially seconded the sentiment.— Mr. E. Edwards proposed the next sentiment: 'The continued enlargement of the means for the cultivation of taste among the people, and for the development of the great mechanical and engineering skill of the English nation', which he enforced by some judicious remarks and allusions to distinguished men who, by cultivating their minds, had raised themselves to their present proud position,-- Mr. J. Fryer seconded the resolution.—Mr. Poyser moved the next sentiment 'The education of the people, as the means of the development of those high faculties with which the All-wise has endowed man; and, as, in this view, the source of the highest and purest earthly enjoyment'.—Mr. M. H. Cantrell seconded the resolution. —Dr. Webb introduced the next sentiment: 'The press, as the greatest providential manifestation of human means for promotion and securing the advancement of literature, science, and civilization', and eloquently pleaded the cause of the Institution.—Mr. W. Wright seconded Dr. Webb's resolution.—Mr. E. Wass proposed, 'The principles upon which these societies are based are those which, while they leave to every man the right of free judgment, yet, from their universality and truth, tend to produce in society the greatest amount of general good'.— Mr. Carrington seconded the resolution.—Mr. Stone proposed 'The Ladies', whose presence that day was one of the good things of the *fête.*

THE ROYAL SOCIETY OF ARTS

JOHN ADAM STREET, ADELPHI, LONDON, W.C.2

FOUNDED IN 1754 AND INCORPORATED BY ROYAL CHARTER IN 1847

PATRON : HER MAJESTY THE QUEEN

PRESIDENT : HIS ROYAL HIGHNESS THE DUKE OF EDINBURGH, K.G.

PROPOSAL FORM FOR MEMBERSHIP

Candidate's Name in full

Nationality

Address

Rank, Profession or Business

I desire to become a Fellow/an Associate Member of the Royal Society of Arts.

Signature of Candidate

Date of Birth

We hereby propose and recommend the above Candidate as a fit and proper person to become a Fellow/an Associate Member of the Royal Society for the Encouragement of Arts, Manufactures and Commerce.

Signatures of three Fellows, at least one of whom must sign on personal knowledge :

Name in Block Capitals	Signature	
[ ]		*(on personal knowledge)*
[ ]		
[ ]		

Read and suspended

Elected

P.T.O.

Details of Candidate's academic and professional qualifications (when a University Degree is quoted the name of the University conferring it should be stated), past and present occupation, and any other relevant information :

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Fellowship of the Royal Society of Arts is open to suitable persons over 21 years of age. Candidates for election must be proposed and seconded by three Fellows, one of whom, at least, must know the applicant personally Fellows are entitled to the following privileges :

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To receive the Society's *Journal.*

To use the Society's Reference and Lending Library.

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Persons who have attained the age of 18 and are under 21 years of age can be admitted as Associates only. On reaching the age of 21 they may decide either to remain Associates until they reach the age of 25, or to apply for Fellowship. They may not remain Associates after reaching the age of 25

Associates are entitled to all the privileges mentioned above, except that they are not permitted to use any designating letters or to style themselves 'Associate of the Royal Society of Arts'.

The procedure for election as an Associate is the same as that for election as a Fellow.

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For Fellows : £4 4s. 0d. per annum, or a life composition fee of £42 0s. 0d There is a registration fee, in addition, of £2 2s. 0d.

For Associates : £1 1s. 0d. per annum. (No registration fee.)

Subscriptions date from the quarter day preceding election. No payment should be made until after election.

R.S.A. PUBLICATIONS

The following are papers and lectures read to the Society in recent years. Copies of e *Journals* in which they were published are obtainable on application to the Secretary. ellows are allowed a discount of 25 per cent. Lists of titles of papers and lectures read earlier years are also obtainable on application.

-IE SAFETY FACTOR IN CONSTRUC-TION. Two Lectures by G. A. Gardner and Prof. F S. Thompson 2/6

HE NOVEL. Three Lectures by Dennis Wheatley, Michael Joseph and Christina Foyle 3/6

HE KEMANO-KITIMAT HYDRO-ELECTRIC POWER DEVELOPMENT. By F. L. Lawton 2/6

HE ASCENT OF EVEREST. By Wilfrid Noyce 2/6

EATHER MODIFICATION AND ITS VALUE TO AGRICULTURE AND WATER SUPPLY. By Dr. Irving P. Krick 2/6

FETY IN TRANSPORT. Three Lectures by Dr. W. H. Glanville, Sir Vernon Brown and Lieut.-Colonel G. R. S. Wilson 3/6

LOUR TELEVISION BROAD-CASTING. By C. G. Mayer 2/6

THE DESIGN OF NEW SCHOOLS. By C. H. Aslin 2/6

LETTER DESIGN AND TYPECUTTING. By Harry G. Carter 2/6

LIFE IN THE YEAR 2000 A.D. Two prizewinning essays 2/6

SCIENCE AND FOOD PRODUCTION. By Dr. L. H. Lampitt 2/6

RESEARCH IN THE COAL INDUSTRY. By Dr. Idris Jones 2/6

THE COPPERBELT OF NORTHERN RHODESIA. By R. L. Prain 2/6

TSETSE FLY CONTROL. By Dr. K. R. S. Morris 2/6

MUSIC (Three Lectures)—IN EDUCATION, by Dr. Greenhouse Allt; IN THE THEATRE, by Leslie Bridgewater; IN MEDICINE, by Frank Howes ... 3/6

VIRUS DISEASES OF PLANTS. By F. C. Bawden 2/6

Strange as he might look arriving at Hatfield Station on an English summer day, the Eskimo would not have to travel far to feel at home. For almost within sight of the platform lies De Havilland's low-temperature test room. Here, gloved and helmeted against intense cold, research workers study the behaviour of aircraft parts under Arctic conditions. The large test chamber in which they work can be

The North Pole comes to Hatfield

cooled to 135° of frost in less than an hour and a half — thanks to 'Drikold', the solid carbon dioxide or 'dry ice' refrigerant made by I.C.I. 'Drikold' is widely used, not only by British aircraft manufacturers and other industries that require coldness without fuss or mess, but also by those needing a convenient source of carbon dioxide gas. In the engineering, ice-cream, meat, fish, brewing, soft drink and many other industries, 'Drikold' plays its part in providing coldness, freshness, 'head' or 'fizz' all the year round.

Thus, and in a thousand kindred ways, I.C.I.'s research and production are serving the Nation.

ICI

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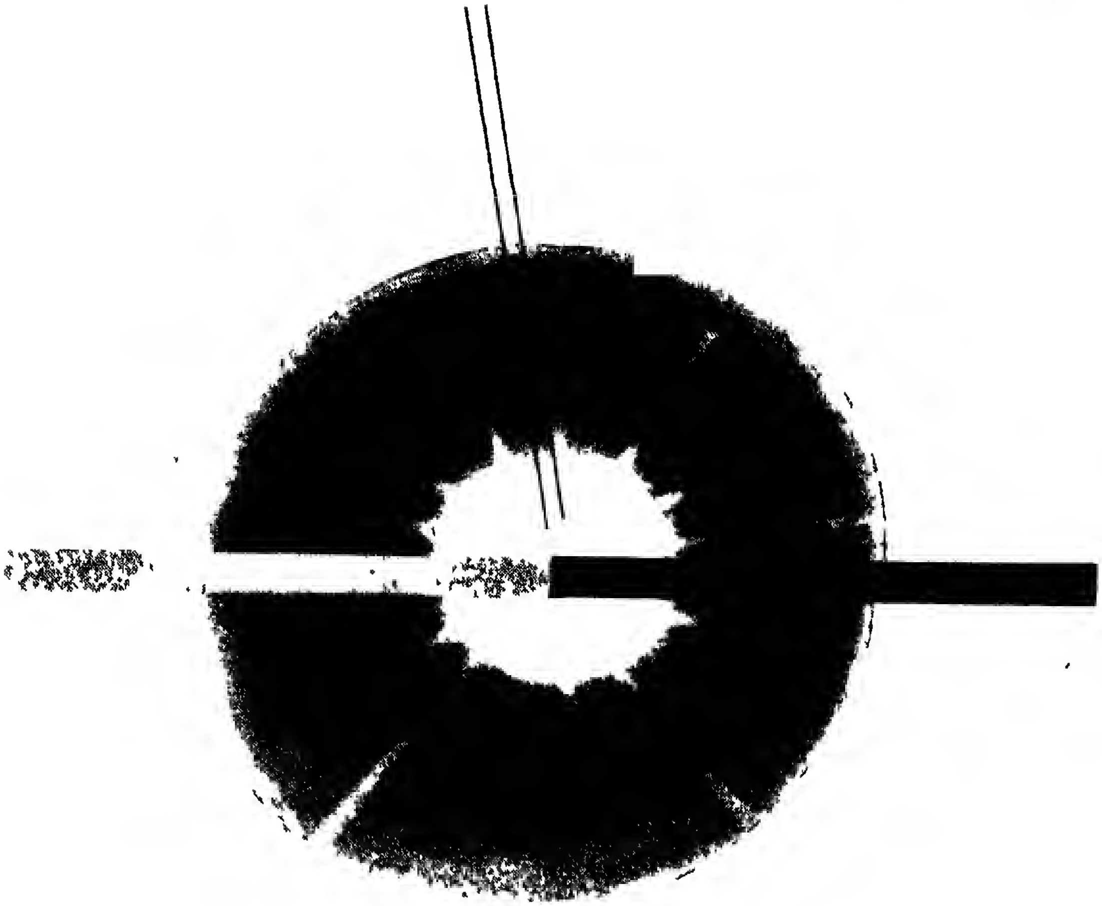


MODERN WELDING

Three Cantor Lectures by

H. G. TAYLOR, D.Sc.(Eng.), M.I.E.E., F.Inst.P.,

Director of the British Welding Research Association

LECTURE I

Monday, 16th April, 1956

In March, 1933, a series of Cantor lectures on Welding was delivered before this Society by Mr. Arthur Stephenson, who was at that time Vice-President of the Institution of Welding Engineers, an institution which later became the present Institute of Welding. These Cantor lectures by Mr. Stephenson make interesting reading to-day. Perhaps the easiest way to indicate the difference between the situation then and now is to mention those processes and applications which were not included in Mr. Stephenson's lectures. There is, for example, no reference at all to automatic welding, either submerged are welding or covered electrode. There is no reference to argon arc welding. The reference to resistance welding is very short: there is, of course, no self-adjusting arc welding which is our latest method of welding and, on applications of welding, there is no reference at all to welded bridges or to the use of welding in structures. There is very little reference to welding in ships and the references to pressure vessels are somewhat restricted. There is a delightful illustration showing a welded pressure vessel with, standing beside it, obviously one of the smallest men in the works, to emphasize the scale of the picture—a device which is quite unnecessary to-day when vessels up to twenty times the height of a man are commonly made by the same company. Mr. Stephenson naturally made great reference to gas welding, which was clearly a most important process at that time. In the course of the lectures which I shall give I shall make practically no reference to gas welding. This is not because it is no longer used, for that is indeed far from the case, but it cannot be described as a modern welding process in the sense that is has been developed in recent times, though it is, of course, still widely used. It is a curious feature that the introduction of something new does not always seem to displace the older method and this is particularly the case with gas welding. The process has been thought to be dying for many years, but in fact it is used more to-day than ever before. One can only assume that the increasing use of welding has led to an increasing field of application for gas welding. We have similar instances to this in everyday life. The introduction of the gramophone by no means displaced the piano, and the introduction of the wireless set had no adverse effect on the sale of the gramophone—in fact, rather the reverse. The provision of news bulletins on the wireless had no adverse effect on the sale of newspapers, and many other such cases could be quoted where, despite the forebodings and the direct predictions of disaster,

things have not turned out that way at all, and this is particularly the case with gas welding. It is widely used to-day, and there are applications for gas welding which cannot at all easily be met by any other process.

When Mr. Stephenson lectured to the Society, there were less than 3,000 welders in this country. By 1951, the number had increased tenfold, and is probably considerably higher again to-day. There are now 15 firms actively engaged in producing arc welding electrodes, and the striking development of this side of the industry is shown by the fact that whereas in 1938 the output of electrodes was only 11,720 tons, by 1944—under pressure of war-time requirements—the figure had increased to 45,000 tons. After the war, there was some reduction, but the output is again of this order to-day.

METAL ARC WELDING ELECTRODES

The metal arc welding process, as distinct from the carbon arc process, was first described in a patent granted to Slavianoff in 1890. In this process a metal electrode is used which not only provides means for making the arc, but also supplies the filler metal for the weld. In the early days of metal-arc welding bare wire electrodes were used. Various problems are, however, encountered when using bare electrodes. Whilst it is reasonably easy to start and maintain a D.C. arc with a bare electrode, difficulties are encountered when using A.C. The time during which the voltage is off usually allows the electrode tip and the parent metal to cool down sufficiently to make re-striking of the arc difficult or impossible when the voltage comes on again. Moreover, at the high temperatures which exist in the molten metal, the affinity of the material for foreign elements is increased, and there is a danger of impurities, mainly oxygen and nitrogen, entering either the molten particles travelling between the electrode and the parent metal, or the molten pool of metal. The oxygen will exist in the solidified steel mainly as ferrous oxide which causes hot shortness in the steel and loss of impact resistance at normal temperatures. Nitrogen produces embrittlement and is responsible for strain ageing.

COATED ELECTRODES

The difficulties contingent on the use of a bare electrode led to the introduction of the coated electrode, a most important and far-reaching development in metal arc welding. In 1907 Kjellberg took out a patent for an electrode to be dipped in or wrapped with a slow volatilizing substance which formed a vapour pocket round the arc. This patent may be considered the basis of shielded arc welding as we know it to-day.

The coating on the electrode serves four main purposes; it provides a gas which stabilizes the arc, this gas also shields the arc and prevents atmospheric contamination of the weld metal; it provides a flux which protects the weld metal and absorbs the impurities and oxides from the molten metal. Finally, the coating provides a means of introducing alloying elements in the weld metal. These various features were not all immediately appreciated by the early inventors. In 1911 Strohmenger drew attention to the advantages of asbestos

as a coating material when treated with sodium silicate. Such a coating was popular for very many years and was still in use thirty years later.

Such electrodes were wrapped with asbestos yarn and dipped. The dipping process was also used without wrapping and, in fact, for a limited range of electrodes is still used to-day. Essentially the process involves dipping the electrode a number of times into a slurry containing the necessary coating ingredients suspended in sodium or potassium silicate. It is sometimes necessary to keep the slurry continuously agitated to prevent settlement of high density minerals, but excessive agitation prevents the liquid adhering to the rod. Success turns on getting the right density of the solution and the right degree of agitation.

A highly significant step in electrode development was taken when, in 1917, Jones patented the extrusion process in which the coating in the form of a stiff paste is extruded through a die around the electrode which is forced through the centre of the die at considerable speed. Further details of the process are given later.

The similarity of the welding process to that of steel-making led to the use of coatings similar to steel-making fluxes—for example, iron oxide and silicon. One such type of coating is still commonly used and is known as the iron oxide type. The coating contains eighty per cent or more of iron oxide and may be used as a 'contact' or 'touch' rod, which minimizes operator fatigue, because the electrode may rest on the work and it is not necessary for the welder to hold a steady arc length. The voluminous slag resulting from the use of this electrode leads to a very smooth surface on the weld. The weld metal is nearly pure iron and naturally has less attractive mechanical properties than some other types of electrode.

The importance of arc shielding has already been referred to and American inventors were the first to introduce cellulosic compounds for this purpose. The theory behind the use of this material is that this compound is decomposed by the heat of the arc, principally into carbon monoxide and hydrogen, large volumes of which are generated from a comparatively small weight of cellulosic material. These gases surround the arc and form a reducing blanket excluding the atmosphere from the vicinity of the molten metal, and thus reinforcing the protective action of the molten slag formed from the metallic and mineral elements of the flux, against the oxygen and nitrogen of the air. Furthermore, the presence in the arc atmosphere of a large percentage of hydrogen raises the arc voltage of the electrode, and thus allows a higher power consumption per unit weight of core wire, making for a faster rate of welding.

The development of the large scale use of arc welding electrodes containing cellulosic material appears to have been associated originally with the A. O. Smith Corporation of Milwaukee, U.S.A., an engineering company which among other things, makes welded pressure vessels for the oil refining industry. The idea once having become familiar, a large variety of materials became available for discovery. The cellulose originally used for the purpose was probably powdered wood pulp, such as is used for paper manufacture, or possibly wood flour itself; though the latter is less satisfactory as it contains other constituents

including a percentage of resin, in addition to cellulose. Wood pulp is practically pure cellulose, but has the property of 'felting' very readily, making the mechanical processes of dry and wet mixing with other powders rather difficult if a completely homogeneous mixture is to be obtained. It appears to have been substituted almost universally by a material known to the trade as Alpha flock. This is simply a wood pulp which has been chemically disintegrated into a powder form by an oxidation process. This oxidation process leaves the chemical constitution of the cellulose molecule practically unchanged but has the effect of breaking down the chemical bonds between the molecules which give the material its fibrous properties. The result is a powder which is much easier to incorporate uniformly into a plastic mixture.

A typical dry flux composition of this type of electrode would, according to Andrews, be as follows:

Alpha flock	40%
White asbestos powder (Chrysotile)	25%
Chemically prepared titanium oxide	15%
Ferro-manganese	15%
Other constituents	5%

The sodium silicate used as a binding agent forms a large proportion of the flux and the amount used has much to do with the success of this type of electrode—the characteristics of which are:

(*a*) high penetration;
(*b*) suitability for welding in various positions;
(*c*) good weld quality in heavy single runs.

A most important development in the electrode field was the appreciation of the utility of natural titanium oxide or rutile as a flux constituent. This material leads to an easy flowing electrode with good properties and good finish, which is very popular with welders. The slag is readily removed which is another attractive feature since it minimises welding time. Probably there are more electrodes of the rutile type used than any other. A possible coating composition is as follows:

Rutile	35% to 55%
Mineral silicates (mica, felspar, asbestos, etc.)	15% to 35%
Ferro manganese	5% to 20%
Basic carbonates (calcium, magnesium, or barium)	5% to 20%

British manufacturers now produce electrodes which are classified in six groups according to their flux covering, and this has now been accepted as a British Standard. The description of the electrode is as follows:

TYPES OF FLUX COVERING

Class No. 1 coverings having a high cellulose content

The covering contains at least 15 per cent of material having a high cellulose content with up to thirty per cent of titania (as rutile or titanium white).

This class of electrode is characterized by a deeply penetrating arc and rapid burn-off rate. Spatter loss is somewhat higher than with electrodes having the mineral type of covering. A voluminous gas shield is formed as a result of the decomposition of the cellulosic material in the arc region. The weld finish is somewhat coarser than usual, the ripples being rather more pronounced and less evenly spaced. The deposit has a thin cover of slag which is friable and thus easy to remove.

Because of its arc characteristics and the small volume of slag produced, the electrode is particularly easy to use in any welding position. With current values near to the maximum of the range, the electrode may be used in the flat position for 'deep penetration' welding.

The electrode is suitable for all types of mild steel welding and is of particular value for applications involving changes in position of welding, for example in pipe welding, storage tanks, bridges and shipbuilding.

Generally, this class of electrode is suitable for use with D.C. with the electrode connected to the positive pole. Some types are available which contain arc stabilizing materials, and may be suitable for use with A.C., although a high open circuit voltage is usually necessary.

Class No. 2 coverings having a high content of titania and producing a fairly viscous slag

The covering contains a high proportion of titania (as rutile, titanium white or ilmenite) and the high content of ionizers provides excellent welding properties.

Electrodes of this class are suitable for butt and fillet welds in all positions and are particularly easy to use for fillet welds in the horizontal-vertical position; sizes larger than 6 S.W.G. (3/16th in.) are not normally used for vertical and for overhead welding. Fillet welds tend to be convex in profile and have medium root penetration. The electrode has smooth arc characteristics and normally produces very little spatter. The slag is dense and completely covers the deposit, but is easily detached except from the first run in a deep v.

The electrode is particularly suitable for use with A.C., and on D.C. may be used with the electrode connected to either pole.

Class No. 3 coverings containing an appreciable amount of titania and producing a fluid slag

This type of covering contains an appreciable amount of titania (as rutile, titanium white or ilmenite), but the addition of basic materials yields a much more fluid slag than that produced by electrodes of Class 2.

Welding in the overhead and vertical (upwards) positions is far easier with this class of electrode than with any other type of mild steel electrode, but its use is not confined to these positions. The electrode has smooth arc characteristics, medium penetration, and normally produces very little spatter. The slag is generally easy to detach, even from the first run in a deep v.

The deposits produced by these electrodes will usually meet radiographic tests of normal standard more readily than those made with electrodes of Class No. 2.

The electrode is suitable for use with D.C. with the electrode connected to

either pole. On A.C. the electrode will usually work satisfactorily with open circuit voltages as low as 45.

Class No. 4 *coverings producing an inflated slag having a high content of oxides or silicates of iron and manganese, or both*

The coverings consist principally of oxides or carbonates of manganese and iron, together with silicates.

The electrode is generally produced with a thick covering and is used for welding in the flat position only. Certain varieties have a thinner covering, and these may be used for welding in all positions but have generally been superseded by other types of electrode. Both types of covering produce a fluid, voluminous slag which freezes with a characteristic internal honeycomb of holes the so-called 'inflated' slag, which is very easily detached. The weld finish is smooth, the ripples being much less pronounced than on deposits produced by the other classes of electrodes. In grooves and fillet welds the weld profile is concave.

The principal application for this class of electrode with a thick covering is for deep groove welding in thick plates, particularly where such welds are subject to strict radiographic tests. Certain varieties of this class of electrode are suitable for 'deep penetration' welding, particularly in fillets.

The electrode is suitable for use with D.C., usually with the electrode connected to the positive pole, and may be used on A.C. with a normal open circuit voltage.

Class No. 5 *coverings having a high content of iron oxides or silicates producing a heavy solid slag, or both*

This class of electrode has a thick covering consisting principally of iron oxides with or without oxides of manganese.

Electrodes of this class are used principally for single run fillet welds where appearance is of primary importance. The covering melts with a pronounced 'cupped' effect at the electrode tip, enabling the electrode to be used touching the work, this procedure being known as 'touch welding'. The degree of penetration is low. A heavy solid slag is produced which is sometimes 'self-detaching' and, in fillet welds, gives a smooth, concave profile.

These electrodes are sometimes referred to as 'dead soft' electrodes, because the weld metal has a low carbon content and a particularly low manganese content. This class of electrode has been used with some success for the welding of certain high tensile steels, and also steels having a higher content of sulphur than those used for structural welding, but on such steels the weld profile may be more irregular.

Weld metal deposited by these electrodes usually has low mechanical properties, the reduction of area and Izod impact values being generally less than the values normally specified.

The electrode is suitable for use on D.C. with the electrode connected to either pole. On A.C. the electrode will usually work satisfactorily with open circuit voltages as low as 45.

Class No. 6 *coverings having a high content of calcium carbonate and fluoride*

Coverings containing appreciable quantities of calcium carbonate and fluorspar

have been in use for a long time, but early types were not very popular with welders in this country. Improved types now available are quite satisfactory when used with the correct welding technique.

This class of electrode should preferably be used for welds in the flat position, but may be used for welds in other positions. The deposit is usually flat but with a marked surface ripple. The slag has a characteristic brown glossy appearance and rarely completely covers the deposit.

Certain makes of this class of electrode are sometimes called 'ferritic electrodes'; this is a misnomer, arising from their use for welding high tensile steels (armour plate) and to distinguish them from the austenitic electrodes used for that purpose. Their value for welding high tensile steel is generally attributed to the low hydrogen content of the weld metal.

To obtain the best results the electrodes should be thoroughly dried immediately before use, in order to remove any moisture they may have picked up during storage. The deposits are sound, and welds made with these electrodes are particularly suitable for fabrications to be exposed to very low temperatures.

The majority of these electrodes are suitable for A.C. or D.C., but when used with D.C. the electrode should be connected to the positive pole.

MANUFACTURE OF ELECTRODES

The method of manufacturing electrodes, and their composition, are secrets which are closely guarded by the electrode industry. Generally speaking, there are no fundamental differences in the method of construction between one electrode manufacturer and another, just as there are general types of electrode coatings which are fundamentally the same in composition. Nevertheless there are, both in manufacture and in composition, minor variations which make all the difference to the cost of production for example in one case, and to the quality of the electrode in the other. With respect to the composition of the coating, it will be well appreciated that competition in the field of electrode manufacture is very severe and any slight advantage which one manufacturer may gain over another may give him considerable profit. Naturally, therefore, he is not willing to disclose the precise composition of the coatings.

TABLE I. COVERINGS FOR PLAIN-CARBON OR LOW-ALLOY STEEL ELECTRODES

Material Formulæ—Parts by Weight

Gas shielded (E6010)		*Gas-slag shielded* (E6012)		*Slag shielded* (E6020)	
Cellulose ...	35	Cellulose ...	5	Iron Oxide ...	30
Asbestos ...	20	Rutile ...	55	Rutile ...	20
Titania	12	Asbestos ...	10	Clay	5
Sod. Sil. ...	80	Clay	10	Asbestos ...	15
		Iron Oxide ...	1	Sod. Sil. ...	70
		Sod. Sil. ...	40		

TABLE II. MINERAL COVERINGS FOR LOW-HYDROGEN ELECTRODES AND ELECTRODES FOR CHROMIUM CONTAINING HIGH-ALLOY STEEL

Material Formulæ—Parts by Weight

Low-hydrogen (E6015)		*'Lime' base type* (EXXX-15)		*'Titania' base* (EXXX-25) *type*	
Limestone ...	40	Limestone ...	35	Titania ...	30
Fluorspar ...	15	Fluorspar ...	30	Limestone ...	20
Cryolite ...	5	Asbestos ...	10	Fluorspar ...	15
Clay	5	Clay	8	Asbestos ...	7
Asbestos ...	5	Ferrosilicon ...	5	Clay	3
Ferrosilicon ...	5	Sod. Sil. ...	23	Ferrosilicon ...	5
Sod. Sil. ...	25			Sod. Sil. ...	28

Tables I and II show the approximate composition of six different types of American electrodes. It is not known how precisely these figures correspond with modern composition formulæ, but it may be assumed that they are generally of the right order and are sufficient to give an indication of the materials which are used in manufacture. The purposes which the various materials which are used in the coating serve, are set out in Table III overleaf, where on the left-hand side are indicated all the usual materials, and along the top the property for which the material is particularly used, such as arc stabilization, formation of slag, binding the coating together, and so on. It will be seen that many of the materials serve more than one purpose, and the importance of the function is indicated by marking it A for important, or B for a minor function.

Reference has already been made to the fact that there are two basic methods of coating electrodes; the first and oldest of these is the dipping process, and it is hardly necessary to explain this in any detail, except perhaps to say that the process is not one which is suitable for high-speed production. It presents considerable difficulties compared with extrusion of electrodes, the second and by far the most important method of construction.

Figure 1 illustrates roughly what happens in an electrode extrusion press. It will be seen that the wire electrode is fed in through a guide which it fits closely, and into the nozzle of the cylinder which contains the coating as a paste. The paste is submitted to a very high pressure, and extrudes through the die or nozzle with which the electrode wire itself is concentric. The paste is in such a dry condition that the paste-covered electrode can be handled on extrusion from the die. This is the essential condition for making high-speed production possible, for the rate of electrode feed is very high, many hundreds a minute. These electrodes, being projected more or less like bullets from a gun, have to be stopped and automatically arranged on a conveyor belt, and passed slowly through a drying oven.

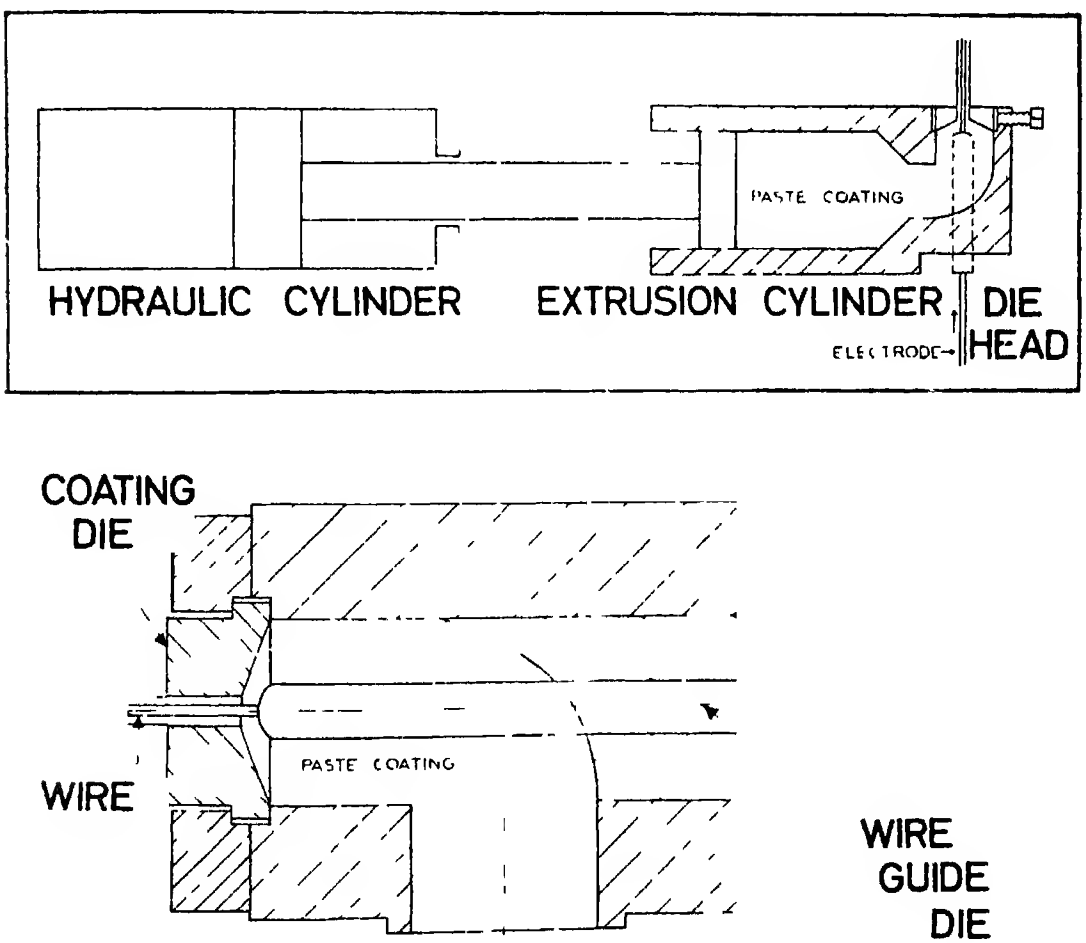
TABLE III FUNCTION OF THE COVERING CONSTITUENTS IN ARC-WELDING ELECTRODES*

Covering constituent	*Arc stabilizer*	*Slag former*	*Reducing agent*	*Binder*	*Coating strengthener*	*Oxidizing agent*	*Gas shielding*	*Alloying weld metal*
Gum and or resin	—	—	B	A	—	—	—	—
Cellulose	—	—	B	—	B	—	A	—
Felspar (alkali aluminium silicates)	B	A	—	—	—	—	—	—
Clay (aluminium silicates)	B	A	—	—	—	—	—	—
Talcs (magnesium silicates)	B	A	—	—	—	—	—	—
Titanates (rutile, titanium dioxide, etc.)	A	A	—	—	—	—	—	—
Iron oxides	B	A	—	—	—	A	—	—
Calcium carbonates	A	B	—	—	—	B	B	—
Asbestos	B	A	—	—	A	—	—	—
Ferro manganese	—	A	A	—	—	—	—	B
Potassium silicates or potassium salt	A	A	—	A	—	—	—	—
Sodium silicates	B	A	—	A	—	—	—	—

A Major function B Minor function

* American Welding Handbook

This describes the essential and perhaps the most interesting part of the operation, but it should, of course, be explained that initially the requisite formula is made up from powders which are usually dry-mixed in the correct proportions, and then sodium silicate or other binder added when mixing proceeds. After this, the moist paste has to be converted into slugs, which can be handled, and put into the cylinder of the extrusion press. For this purpose, what is known as a slug-press is used, which compresses the paste and makes it into a suitable form for handling. The piston of the extrusion press is then completely withdrawn, and the slug of paste inserted in the cylinder. The piston is then returned, and a very high pressure exerted to cause extrusion. In a typical extruder the maximum thrust is 175 tons, the capacity of the cylinder is 1,220 cubic inches, and the maximum extrusion pressure 11,400 pounds per square inch. According to requirements, the flux cylinder bore can be increased or decreased. A larger bore gives more capacity at a lower extrusion pressure, and a smaller bore less capacity at a higher extrusion pressure. The choice of pressure is, of course, determined by the manufacturer's own requirements, and the type



[By courtesy of Haylock Engineering Co., Ltd

FIGURE 1. *Electrode extrusion press*

of electrode which he is manufacturing. The operating times of the press are approximately as follows:

quick return—six seconds; rapid advance—twenty seconds; extrusion stroke at high speed takes three minutes.

A complete cycle at maximum extrusion speed can be completed in four to four and a half minutes, including the loading of slugs. This is just a typical machine, and others have different characteristics. The impressive feature perhaps to be noted is the fact that the extrusion pressure on the paste is no less than five tons per square inch.

This describes the commonest method of electrode extrusion but, in fact, other processes are known in which the paste is fed forward by a screw, much, for example, as in the case of the continuous extrusion press for lead sheathing for cables. The wire may be fed in continuously, and cut on the exit side of the machine, but much more generally it is cut prior to being fed into the machine and is fed in automatically. The speeds of feed are as high as 1,000 feet per minute; that is to say, over 600 18-inch electrodes per minute have to be coated. The speed of feed must be capable of fine control, since it is necessary to match the speed of feed to the rate of paste extrusion in order to ensure that the proper coating thickness is attained. Very high quality is expected from electrode coatings. Concentricity must be of a high order, and this is one of the greatest difficulties with the process, though it is possible to-day to have automatic control of concentricity. It is usual to measure this by means of some form of electronic device. Many different kinds of feeding and conveying mechanism have been used in conjunction with extrusion presses; frequently, these are constructed by the electrode manufacturers themselves. Essentially, however, the feeding must, as indicated, be controllable to a high degree of accuracy so as to get the speed right, and the electrodes must be fed one behind the other without any gap between; in fact, one electrode pushes the next one through. It is an essential, though a small feature, that the electrode wires should be cut very accurately, and should not have burrs on the end, otherwise unsatisfactory operation will result.

On the exit side, after the electrodes have been stopped, they are traversed on a belt and the first operation is to remove the paste from one end of the electrode by brushing so as to enable the electrode to be clamped subsequently in an electrode holder. The coated electrodes are then traversed through a drying oven at slow speed, and sometimes this is preceded by a certain amount of air drying. The drying temperature is of the order of 110–120° C. for the majority of electrodes. The process is a continuous one, and on coming out of the drying oven, the electrodes are immediately either counted or weighed and packed into air-tight containers. This is the general procedure with respect to drying electrodes, but reference may be made here to the fact that low-hydrogen electrodes must have an additional drying period at a considerably higher temperature.

SPECIAL ELECTRODES AND SPECIAL APPLICATIONS

The low-hydrogen electrode is one of the most important developments in

metal arc welding in the last ten years. During the war, it was perhaps first realized what an important *rôle* hydrogen played in weld metal, and it was discovered that its presence was closely related to the tendency of welds to crack. This was first pointed out by Hopkin, and there followed the development of what is known now as the low-hydrogen electrode. It was immediately apparent that water in one form or another was a prime source for introducing hydrogen into weld metal and, therefore, the low-hydrogen electrode was developed by means which would minimize the water content of its coating. There are two ways of doing this; one is to use a covering containing the minimum possible content of hydroscopic or combined water, and the other is to drive off as much water as possible in manufacturing the electrode. Both methods are used jointly, a combination of the proper choice of coating minerals with heating to a high temperature for drying. This naturally increases somewhat the cost of the electrode as compared with rutile electrodes, but the advantages are quite outstanding, and in certain circumstances the use of low-hydrogen electrodes is the only solution to satisfactory welding. Such electrodes have a high capacity for welding hardenable steels without cracking occurring in the heat-affected zone of the parent plate. The deposits are relatively free from micro fissures, also they have very good notch toughness at low temperatures and a much greater resistance to cracking in restrained welds than other types. Some of the early low-hydrogen electrodes had impact properties of fifty to seventy ft./lbs. at room temperature, whereas to-day 100 ft./lbs. is not unusual. The ductility of the weld metal has also improved by some ten per cent during the time of the use of such electrodes. It is interesting to record too that whilst rutile electrodes may have an Izod impact value at -70°C. of five to ten ft./lbs., a figure of twenty ft./lbs. is not exceptional for good quality low-hydrogen electrodes. A few years ago only two electrode manufacturers in this country were making a low hydrogen electrode; now all British manufacturers produce them, some in a range extending from mild steel to alloy steel with a tensile strength of seventy tons per square inch. There are to-day still developments in these electrodes, particularly aiming towards easy operation. It must be admitted that they are generally less easy to run than rutile electrodes, and every effort to improve their quality is worth while. Efforts are also being made still to improve the ductility, the tensile strength and the impact resistance, both at room temperature and at low temperatures.

One could wish that there were signs of progress towards minimizing the fume trouble which arises with these electrodes. Fluorospar is used in the coatings, and this gives rise to fluorine fumes which appear to be more unpleasant to the welders than ordinary welding fumes. A good deal of trouble has been caused from this source, and it is by no means certain whether there is any risk to health or whether the welder just suffers temporary discomfort. The broad solution appears to be to improve the ventilation where such electrodes are being used. When the work is being done in the open air or the semi-open air or a large shop, very little trouble arises. The chief trouble from fumes occurs in confined spaces, and naturally it happens that sometimes welding with

low-hydrogen electrodes in such places is unavoidable. Then the only solution is to have a proper system for extracting the fumes, and perhaps to minimize the amount of time that the welder is exposed to such an unpleasant atmosphere.

It is well recognized to-day that the increasing temperatures and pressures which are used in power plant, call for better and better qualities of steel, but it is perhaps not generally realized that every improvement in the quality of steel—for example, in its creep properties, its fatigue resistance, or its notch toughness—demands that similar improvements should be made in the weld metal which is to be used in association with such materials. This places a great demand on the electrode industry, and research is continually in hand to match these improving characteristics of the base metal. In modern steam power stations, it is by no means unusual for pipes to operate at 500° C. (that is 930°F.) at which temperature the steel is nearly red hot and at this temperature weld metal must be satisfactory. To-day it is virtually impossible to imagine the construction of high power steam plants without welding, and there is no likelihood of any reversion to any other method of joining up steam pipes. In fact, the higher the temperature and pressure, the greater the demand for the use of welding. The industry has no option but to follow as fast as it can the developments in steel and operating conditions. Table IV gives some evidence of the characteristics which may be expected from modern electrodes. The silicate oxide type is shown together with two rutile electrodes and a number of low hydrogen electrodes including some specially useful for high-pressure high-temperature applications.

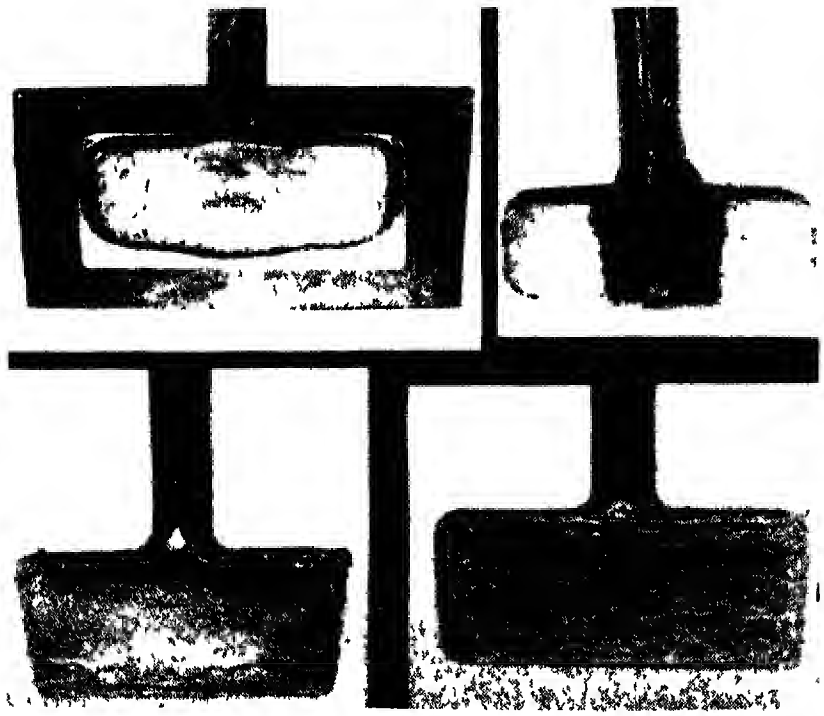
An unusual application which has recently been met, is an electrode having a high impact strength at the temperature of liquid air, namely, −190°C. A welded vessel has been made for operation at this temperature, and others are in course of construction. The electrode had at this temperature an impact resistance measured by the Izod test of ten foot pounds. Another problem facing the electrode manufacturers is the matching of electrodes to a particular steel. The requirements for gas turbines call for continuous operation at temperatures from 600 to 850°C. With prolonged operation at these temperatures, stainless steel containing a small amount of ferrite—as it must to avoid cracking when welding under conditions of restraint—is very liable to develop what is known as the sigma phase, a condition in which the impact strength and creep characteristics are poor. The steel is chosen very carefully to avoid this, and great skill is required to match an electrode so that the weld metal does not run into the same trouble. It is essential, for example, that the ferrite content of a mainly austenitic weld metal should not fall too low, otherwise cracking will occur during welding, neither should it be too high, otherwise the sigma phase will be encroached upon. There is some evidence that the amount of ferrite required to avoid cracking is linked with the amount of sulphur and phosphorus present; the lower these elements are, the less the amount of ferrite required and consequently the less the risk of sigma formation.

As a result of this situation, electrode manufacturers to-day are frequently making special electrodes to match particular steels. It is of interest to record that the magnetic permeability of the steel may be used as an approximate

TABLE IV WELD METAL PROPERTIES

Electrode	Type	Weld Deposit Analysis					Physical Properties (all weld metal test pieces)				
		C %	Mn %	Ni %	Cr %	Mo %	Tensile strength tons/sq in	Yield point tons/sq in	Elongation %	Reduction of area %	Izod ft lbs
Silicate oxide type	Downhand electrode	0.06	0.35	—	—	—	31	28	28	45	50
Rutile type	do	0.06	0.65	—	—	—	33	30	28	55	60
Do	All position electrode	0.06	0.4	—	—	—	34	31	30	60	65
Low-hydrogen type	General purpose	0.08	0.9	—	—	—	35	31	30	70	90
Do	High tensile } All position	0.08	0.[illegible]	1.6	—	0.4	45	40	28	60	55
Do											
Do.	Creep resisting	0.08	0.9	—	1.25	0.5	47	42	23	61	50
Do	do	0.08	0.5	—	2.25	1.0	45	39	24	71	30
Do	do	0.08	0.5	—	4.5	0.5	50	—	20	50	—

measure of the ferrite content, and this has led to the development of a very simple device whereby the quality can be checked very readily. The device is known as a 'Ferrometer', or in its more popular pocket form, an 'Elcometer'. It is a pocket sized instrument, and its operation is based on the principle that the increase of magnetic flux directly between two soft iron probes of a U-shaped magnetic circuit, reduces the forces on a spring-loaded magnetic needle in a parallel magnetic branch. The tension of the spring can be adjusted so that the needle gives a scale reading corresponding to the ferrite content of a standard reference sample. In this way, using a set of standard samples for materials of different thicknesses, the ferrite content of production welds can be rapidly and easily checked. The range of the instrument is 0–30 per cent ferrite.



[By courtesy of Murex Welding Processes, Ltd

FIGURE 2. *Ballast tamping heads before and after welding*

A general development which is taking place all the time is the improvement of mild steel electrodes so that they permit easier welding in specified positions. Another important application is the use of welding for hard surfacing. This is an old story, but the demands being made by the engineer on the electrode manufacturer are increasing all the time. It is in many cases essential that the surface should be as resistant as possible to wear, consistent with the absence of brittleness which would result in bits of the weld metal chipping off. A particular case of some interest is in the mechanical tamper which is used for tamping the ballast on railway lines. This is an old operation which has been done by hand in the past, but to-day mechanical tampers are used. The tamping heads, of which there are 16 in operation at once, have an amplitude of movement in the ballast of half an inch and operate at 28 blows per second. The wear on the head

is naturally considerable, and they can only be kept in condition by frequent re-welding. An illustration of such a head is shown in Figure 2, together with the shape of it both before and after building up by welding.

The versatility of arc welding electrodes for hard surface application is quite remarkable. Surfaces can be provided ranging from the 250 V.P.N. required for clutch dogs on coal mining equipment or forging die blocks, to the 1800 V.P.N. of tungsten carbide grains deposited in a steel matrix on the tips of mechanical coal cutter picks, plough shares or horse-shoes.

It is perhaps of some interest to extend this list of applications. In the least hard range are the surfaces which are work-hardening due to the ready break-down of austenite to martensite. Deformation in service of the surface layer of a weld with this type of electrode immediately produces a relatively hard skin with a high resistance to abrasion, whilst the remainder of the deposit remains soft and ductile. Steel containing 12 to 14 per cent manganese, is frequently used for this purpose. This matches the composition of commercial manganese steel, and is particularly useful for rail crossings and dredger bucket lips. It is not unusual, with this type of coating, to provide a more ductile buffer layer between the base metal and the hard surface, thus minimizing cracking or chipping off. In this field are other electrodes producing work-hardening characteristics, but also providing a degree of corrosion and heat resistance.

Typical applications where work-hardening is required are: excavator teeth; stone crusher segments; swing hammers; coke oven pusher heads; valve seats.

In the non-austenitic group of hard surfacing electrodes, the degree of hardness depends on the rate of cooling after welding the greater the rate of heat loss, the greater the hardness. Naturally the hardness can be controlled by heat treatment subsequent to welding.

With suitable choice of electrode and the use of temper hardening, it is possible to attain a hardness approaching 1000 V.P.N. -a hardness required by metal working or wood working cutting tools.

A hardness of about 350 V.P.N. is required by tractor track links and drive sprockets, steel mill rolls and mud pump valves; 650 V.P.N. is required by bulldozer blades, excavator teeth, scarifier teeth, scraper blades, pug mill knives (in brick-making machinery) and hot punches.

The use of tungsten carbide, referred to above, is commonly effected with a tubular steel electrode in which the carbide granules, with a suitable fluxing material, are held within the tube. Such a method is applicable for gas welding or for carbon or metal arc welding. Alternatively tungsten carbide inserts may be secured by welding. Many grades of tungsten carbide are used according to the application which may include rock drill bits, post hole augers, plough shares, shredding knives in the paper industry and many other applications particularly in connection with oil drilling, mining and agriculture.

It may safely be said that the introduction of these various types of electrode has revolutionized the problem of maintenance in many industries. The ease and economy with which worn parts may be repaired and made good by welding, has made a vast difference in the use of many types of machinery.

An interesting development in metal arc welding is the introduction of what are called 'contact' electrodes. These have an unusually heavy flux coating which contains such an amount of iron powder that the coating is conducting and the electrode is, therefore, self-starting when the coating touches the work. Because of the thick coating, the arc is shielded more effectively than with normal electrodes, and there is some directional effect which gives deeper penetration. Other advantages are that the welder is less fatigued than when using a normal electrode because with the latter he must hold a steady arc length, whereas, with the former, he need only rest the electrode on the work and keep the angle of inclination right; and also higher deposition rates are obtained than with other types of electrodes. These modern 'contact' electrodes, which were introduced in Holland immediately after the war, should not be confused with the older 'touch' electrodes (Class 5 coating) referred to earlier. The modern 'contact' electrode produces welds with a strength suitable for most requirements.

Another development in electrodes involving the use of a high proportion of iron powder in the coating is the so-called 'iron powder' or 'high recovery' type. The latter term originates from the fact that, due to the high proportion of iron powder in the coating, the amount of metal deposited (or the 'recovery') is 140 per cent or more of the metal in the core wire. Very high deposition rates are obtainable with this type of electrode.

Both the 'contact' and 'iron powder' or 'high recovery' electrodes have been adopted more readily and widely on the Continent and in the United States than in this country. In this case the conservatism and slowness to adopt new ideas of which we are often accused is not without justification. The high deposition rate obtainable with these electrodes is of great value but some doubts have been expressed as to whether the enthusiasm with which these electrodes were introduced and acclaimed were justified. However, when correctly used in suitable applications they have definite advantages, but some discretion is necessary in their use and application. Neither these nor any other type of electrode is the answer to all welding problems.

Another development which makes slow progress largely it is believed because of difficulties over agreement on piece-work rates rather than for technical reasons- is the twin multiphase electrode. The process is one in which two electrodes are bound or formed together, and are operated on a two-phase supply fed from a 3/2 phase Scott connected transformer. With this arrangement arcing is always taking place between the work and one electrode or the other, and for this reason, ionization of the arc is continuously maintained. It is thus possible to use a much lower open circuit voltage and still to obtain very smooth welding and easy striking. This advantage has the very important effect that the power factor of the supply taken is correspondingly improved, since the power factor is approximately equal to the ratio of the arc voltage to the open circuit voltage. Figures as high as 0·65 have, in fact, been obtained. Another and major advantage is that a load is taken which is equally balanced on the three phases. An incidental advantage also is that with the lower open circuit voltage, the system is inherently safer from the point of view of shock risk. Furthermore, it

is claimed that higher welding speeds are achieved. In one particular case, 900 kW. seconds was required from a single-phase supply to weld a 5/16-inch fillet, 12 inches long in mild steel, as compared with only 770 kW. seconds for producing the same weld from a three-phase supply.

AUTOMATIC PROCESSES

Covered electrodes

Efforts are always being made to secure greater uniformity in welding and to secure a greater output per operator. The former advantage can be achieved by an automatic plant which has recently been introduced in Sweden, which uses normal arc welding electrodes. The machine has a magazine which is kept filled with normal electrodes, and these are automatically fed towards the work at a rate dependent upon the arc voltage. When the electrode is consumed, a second one takes over, the stub end being ejected. The device is said to work very satisfactorily, and clearly will give very uniform welding. It is not so obvious however that the output of such a plant would be in excess of that of a single skilled operator, though conceivably one operator could look after several machines. The more common method of doing automatic welding with covered electrodes is to form the electrode into a coil and to feed it continuously towards the work at a rate controlled again by the arc voltage. There are several machines of this type available, the only fundamental differences between them being in the method of making electrical contact with the electrode. In some cases the electrode is specially wrapped with spiral wire, which protrudes through the coating and with which contact is made. In other cases the coating is removed on opposite sides of the diameter by a special cutter, and contact is made with the core wire through the slots thus created. Machines of these types are fairly common and are successfully used on many different kinds of work.

Submerged arc

In October, 1935, Jones, Kennedy and Rotermund filed a patent in the United States for an automatic welding process using a powdered or granulated flux and a bare welding wire. The patent is said to have arisen from the need for a method of welding a very long oil pipe-line. Something of a similar nature had been known before, but the type of flux used caused excessive generation of gases and moisture, and led to porous welds. The essential feature of the new patent was that the flux was chemically stable and when melted was conducting. Whether an actual arc is formed or not by this process, seems to be still undecided. Certainly the original inventors believed that they were providing resistance heating, and a recent private intimation from the Professor of Metallurgy in Moscow University confirmed this view; but the generic name to describe the process is submerged *arc* welding.

It is sufficient, however, to say that there is no visible arc, that the process permits the use of currents up to 5,000 amps and consequently the welding of thick plates with very few passes. A three-inch plate can be welded with a single pass. Excess of granulated flux flows over the weld preparation and combines

with that part which melts to provide an effective cover for the weld whilst it is cooling.

According to the original inventors, the desirable features of the flux are as follows:

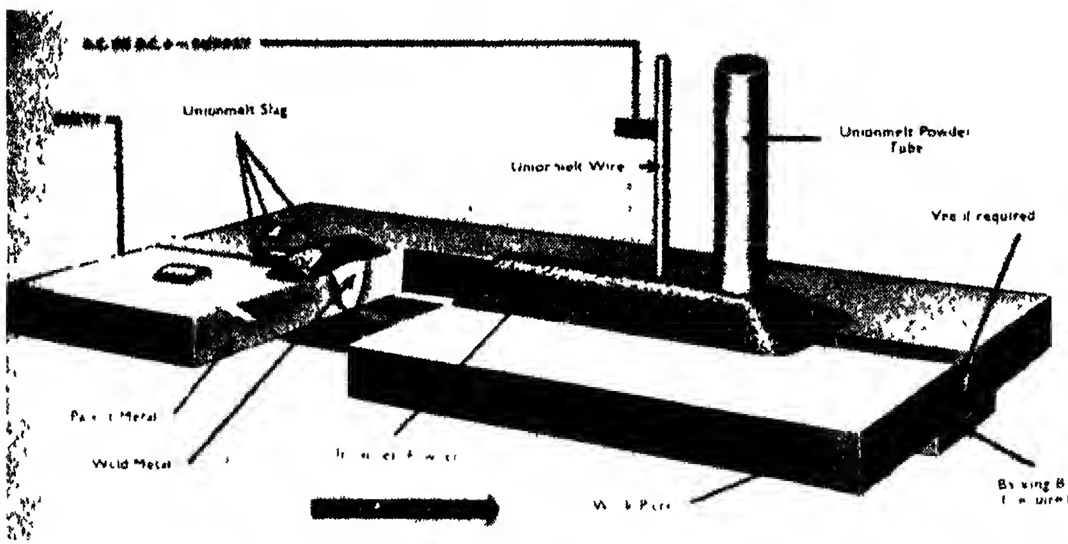
(1) The chemical reactions between the components of the welding flux must be completed before it is used in welding. Failure in this respect most surely invites porosity.

(2) It must be capable of controlling the penetration and the width of the weld.

(3) The fluidity at welding temperatures must be such that it will not become entrained with the molten metal.

(4) It must contain only chemicals which are not detrimental to the steel.

(5) It must be readily removable from the finished weld.



By courtesy of Quasi-Arc Ltd

FIGURE 3. *The submerged arc welding process*

These results are apparently achieved with a flux which is made by firing together and granulating: 27 to 38 parts of lime; 9 to 16 parts of magnesium, sixty parts of silica; four to six per cent of alumina; and six per cent of calcium fluoride.

Table V gives the compositions of four different grades of flux available to-day from one supplier. With the exception of the fourth grade, where manganese dioxide replaces lime, magnesium oxide and alumina, it will be noted that there is comparatively little change in composition from the claims of the original patent. Some years after the first patent, Cohn filed one for a flux consisting of about sixty per cent alumina, forty per cent silica and 0·6 per cent of titania, and a small amount of sodium fluoride. This was processed at a high temperature but not vitrified. There are to-day a number of sources of supply of powdered flux, and different grades are used for different purposes. An interesting feature of this method of welding is that twice as much parent metal is melted as electrode

consumed. While, as indicated above, very heavy single passes may be made by the submerged arc process, such extreme thicknesses are not now popular. A very common operation, for example, is the welding of one-inch thick plate in a single pass at about ten inches per minute, using 1,500 amperes at an arc voltage of 38.

TABLE V. ANALYSIS RANGE OF UNIONMELT POWDERS

Grade	20	70	80	50
	%	%	%	%
CaO ...	24/29	25/31	23/26	4/6
CaF_2 ...	—	—	4·5/6	4/6·5
MgO ...	7/8	6/7	10/13	—
SiO_2 ...	50/57	45/50	37/39	40/43
Al_2O_3 ...	4/7	4/7	12/14	2/3
MnO ...	—	9/11	7/8	0·5/1·0
FeO ...	0·7 max.	0·7 max.	0·7 max.	—
TiO_2 ...	0·7 max.	0·7 max.	0·7 max.	—
B_2O_3 ...	0·05 max.	0·05 max.	0·05 max.	—
Pb ...	0·005 max.	0·005 max.	0·005 max.	—
Fe_2O_3 ...	—	—	—	1/3
S ..	0·04 max.	0·04 max.	0·04 max.	-
MnO_2 ...	—	—	—	39/40
BaO ...	—	—	—	2·0 max.

An unusual application of submerged arc welding occurred in the recent manufacture in the United States of a 50,000 ton Loewy forging press. The six upper crosshead beams for this press weighed 150 tons each, and the joining of the web to the flanges involved welds in material no less than 12 inches thick (Figure 4). The successful accomplishment of this task in which over two tons of weld metal were laid down for each beam, was an outstanding achievement. The press also has six lower crosshead beams of similar construction, but with webs only ten inches thick. The six laminated 100-foot columns of this press weigh 100 tons each, and the total weight of the whole machine—the largest in the world by a considerable margin—is 10,000 tons. Although nominally a 50,000 ton press, it is said to be capable of exerting a force of 61,000 tons.

A modern development of the submerged arc process is the use of two heads in series. This variation gives little penetration, and is therefore unsuitable for normal welding, but particularly suitable for cladding processes. Another modern development is the use of two separate heads with separate power supplies but operating within a few inches of one another. Figure 5 shows an example of this, and it is interesting to note that with one application on half-inch plate, a speed of 14 inches per minute was achieved with a single head, but with two heads the speed increased to 32 inches per minute. This method has recently been applied

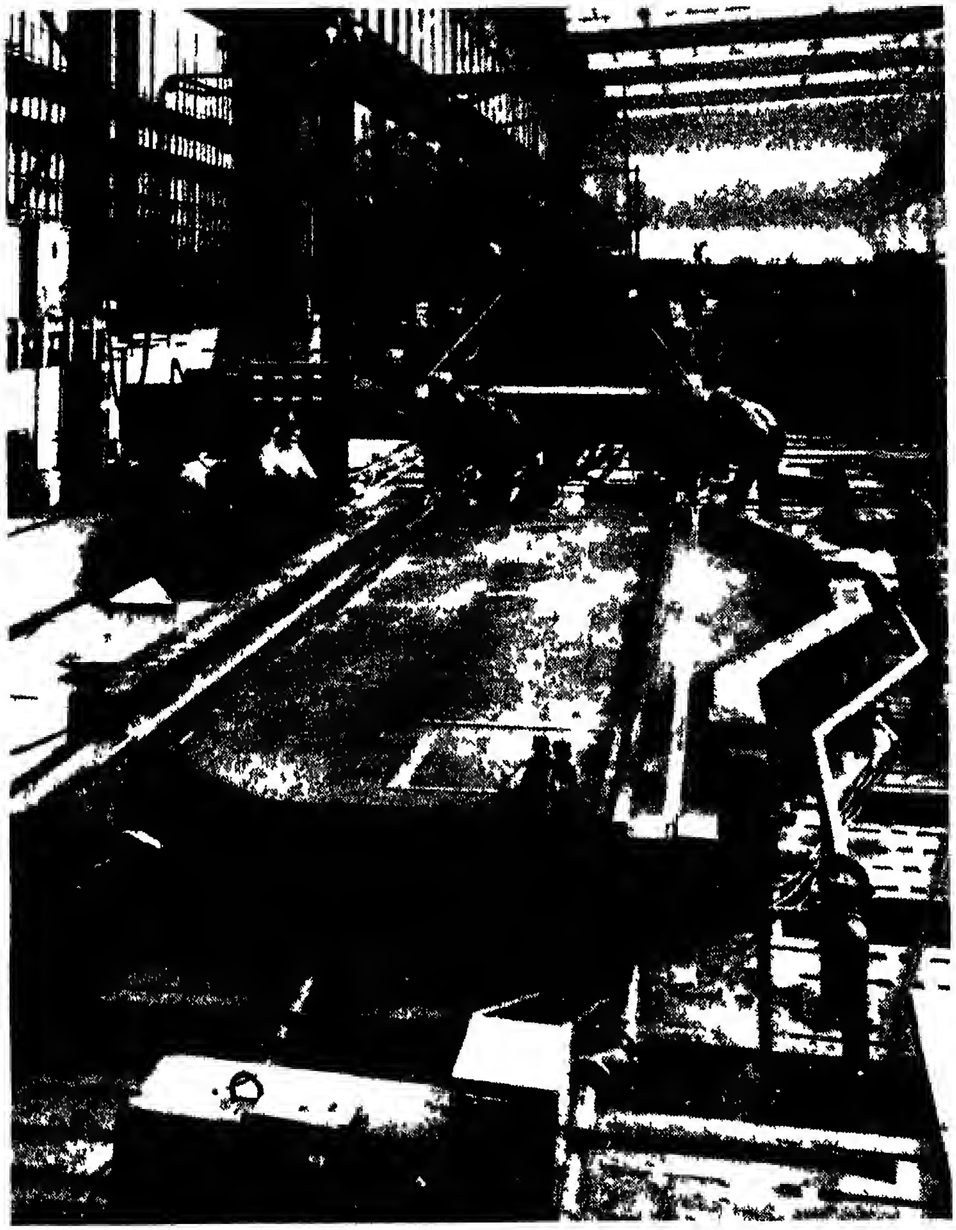
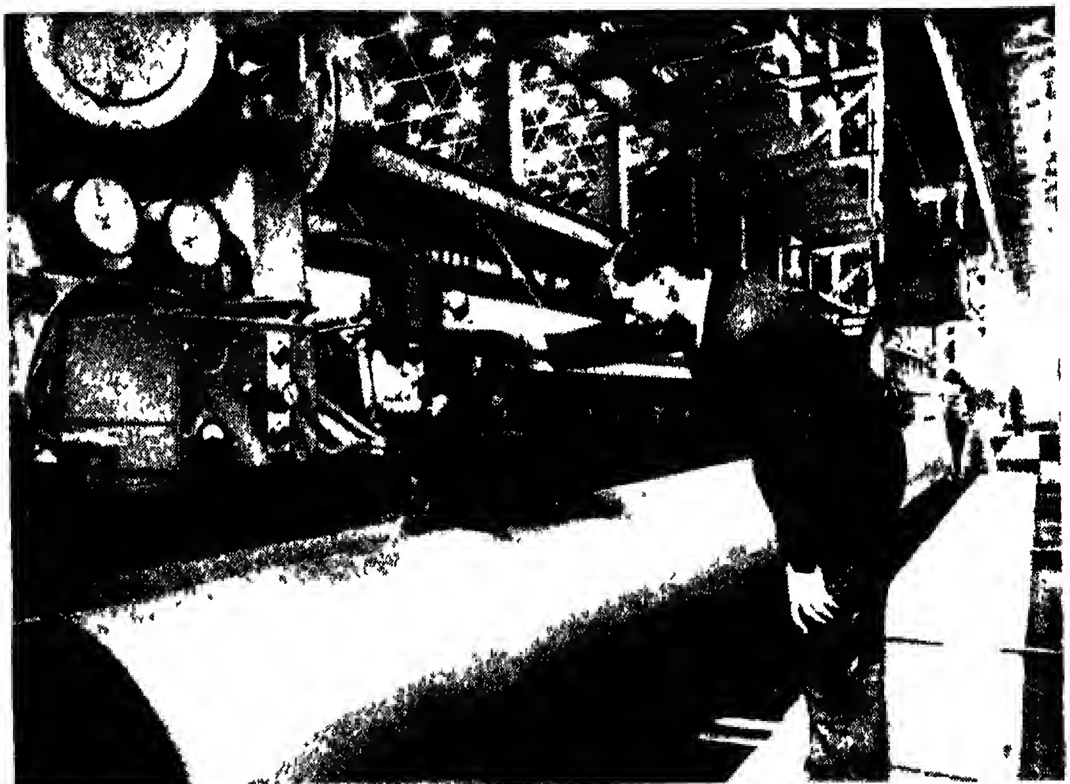


FIGURE 4. *Submerged arc welding of 150 ton crosshead beam for large forging press*

by a British company to the manufacture of large diameter pipes. For the intern longitudinal welds normal submerged arc machines are used but for the extern weld twin arcs are employed. The method is claimed to be fifty per cent fast than any other automatic method, and on ⅝ inch thick pipes speeds up t 36 inches per minute have been obtained.

Yet another variation of submerged arc welding is the semi-automatic proce in which an electrode gun is held in the hand. A continuous coiled electrode used and fed through a flexible cable to the hand gun. The melt is supplie through an inverted conical container on the gun or, alternatively, through a lar

flexible tube which carries also the electrode. Current connection to the electrode is made in the gun through sliding contacts. The arc length is maintained uniform in the usual way, and for this reason the control required by the operator is less than with hand welding. There is, however, the disadvantage that he is not normally able to see the line on which he is welding, due to the presence of the powdered flux, and this causes considerable difficulty unless the work is of a type which can be rotated. It is, therefore, generally felt in the industry that the scope for this semi-automatic device is somewhat limited.



By courtesy of South Durham Iron & Steel Co. Ltd.

FIGURE 5. *Twin arcs for submerged arc welding of pipes*

It is interesting to note that the Russians make good use of submerged arc welding and have even applied it to the welding of thick aluminium—a practice which is unknown in this country. Another interesting Russian development relates to the welding head. This normally controls the speed of the wire so that the arc voltage is a constant. If the arc voltage deviates from normal, the feed speed is altered so as to restore the proper value. This is the normal practice with British and American machines, but it is much more common in Russia to use a head which feeds the wire forward at a constant speed. This speed has a continuous or stepped variable control but, once set, the speed of the wire does not change.

The ability to operate at a constant speed was an important discovery and is said to have had a large influence on the introduction of automatic welding in

the U.S.S.R. It will be appreciated that the current from the normal welding generator increases as the arc length decreases and, provided the wire feed speed is approximately correct, the arc length becomes self-adjusting so that the burn-off rate is equal to the feed rate. It is unlikely that the response would be sufficiently quick to satisfy hand welding, but with the steadier operating conditions of automatic welding, it becomes quite feasible.

ARGON ARC WELDING

The need to shield the welding arc, the hot pool of molten metal, and the adjacent hot metal from the surrounding air, was realized quite early in the present century, but curiously enough the most direct method of doing this, namely to shield the hot parts with a separately supplied gas, was not introduced until some thirty years later. As has already been explained, the method of effecting this shielding with a metal electrode is to provide a coating which vaporizes in the heat of the arc and provides the shielding gases. The more direct method was introduced in the early 1940s, when an American aircraft company used the inert gas helium when welding thin gauges of magnesium and stainless steel sheet. The heat for welding was supplied by an electric arc maintained between the work and a tungsten electrode held in a special holder or torch. Helium gas was passed through the handle of the torch to a nozzle surrounding the tungsten electrode where it flowed over the hot electrode and molten pool protecting them both from oxidation by the atmosphere.

This process is made possible by the fact that the tungsten electrode, although melted at the tip, is consumed only very slowly. Alternative electrodes have been used, such as carbon and molybdenum, but these are quite exceptional and practically all the work is done with a tungsten electrode of which there are at least two varieties, one consisting of plain tungsten, and the other tungsten with a small percentage of thorium to give superior electronic emission characteristics. The high heat input, absence of flux, and the suitability for mechanization, attracted considerable attention to the process. The original method used a direct current arc and was confined to the welding of magnesium alloys and stainless steel. Later a superimposed high frequency spark was used to facilitate the striking of the arc. Within a few years, high purity argon had been used to a large extent to replace helium for manual welding, and direct current had given place to alternating current as the power supply, and many other materials had been welded.

The process is used with particular success for welding aluminium alloys where the absence of flux gives greater scope to the engineer, since fillet welds, and other types of joint in which flux might be trapped, can be safely employed. Excellent weld strengths are also obtained, partly as a result of the increased welding speeds. In this country helium arc welding is practically never used due to the unavailability of helium. Argon arc welding is used for butt, edge, lap and fillet welds in a wide range of thicknesses. It is essentially a method of producing high-quality welds and, although it is at its best when used in the down-hand position, it is possible with skill to make welds in all positions.

Being an arc welding process, the welding heat is concentrated and the heat-affected zone is limited. Distortion is less than with gas welding. Thick material and intricate parts can all be welded satisfactorily, advantages of particular importance in the fabrication of chemical plant and equipment for the aircraft and aircraft engine industries. Although the method may be used for quite thick material, it is generally found that other processes are more economical.

Alternating current is most commonly used for argon arc welding, but it is also possible to use direct current with the electrode either positive or negative. The electrode positive is used sometimes for materials with a tough oxide film, such as aluminium or magnesium, but the electrode becomes overheated at quite low currents, and the use of this arc is therefore limited. Electrode negative arcs are used more often, but only for welding materials where the oxide film is readily broken down or dispersed, such as copper-base alloys, stainless steel and mild steel. When the electrode is negative, it does not become so hot and very high currents can be used. The A.C. arc must be used for all high current welding of materials with refractory oxides, because in argon arc welding the arc has two functions to perform, the supply of heat and the removal of oxide from the edges of the joint. With other welding processes, oxide removal is generally accomplished by a flux or by the atmosphere over the welding pool. In the argon arc process, the oxide surface is removed by an action, partly physical and partly mechanical, which occurs only when the electrode is positive. The A.C. arc therefore combines the advantages of oxide removal when the electrode is positive with the cool running of a negative polarity electrode. The use of A.C., however, introduces difficulties, and special devices are required to start and maintain the arc.

When the electrode is negative, the arc burns satisfactorily, but when the voltage is reversed so that the electrode becomes positive the arc goes out and will not re-ignite unless at that instant there is sufficient voltage available at the transformer. The voltage necessary to cause re-ignition of the electrode negative/positive change varies according to the material being welded and the characteristics of the transformer. With some types of transformer, dangerously high open-circuit voltages would be required for welding aluminium. This danger can be avoided by using a special device to inject the necessary high voltage at the critical moment of the change-over from negative to positive. This can be done by what is known as a high-frequency ionizer, but this device causes radio interference which may be a source of considerable trouble.

As an alternative, use may be made of the Electrical Research Association's surge-injector unit. This device injects a single pulse of moderately high voltage direct current timed accurately for the period when no current is flowing. The arc is ignited directly in a manner which does not cause radio interference, and welding transformers can be used with open-circuit voltages lower than is possible when a spark ionizer is employed. Figure 6 shows the cross-section of an air-cooled and water-cooled torch in essential details. The argon gas is directed on to the weld pool through a ceramic or water-cooled metal nozzle. Formerly

ceramic nozzles were used for all work, but with high currents they are unsatisfactory because of the rapid heating and cooling which causes them to crack. Metal nozzles are, therefore, preferable for all work over 100 amperes. They give greater economy in argon, and better accessibility because a smaller diameter nozzle can be employed

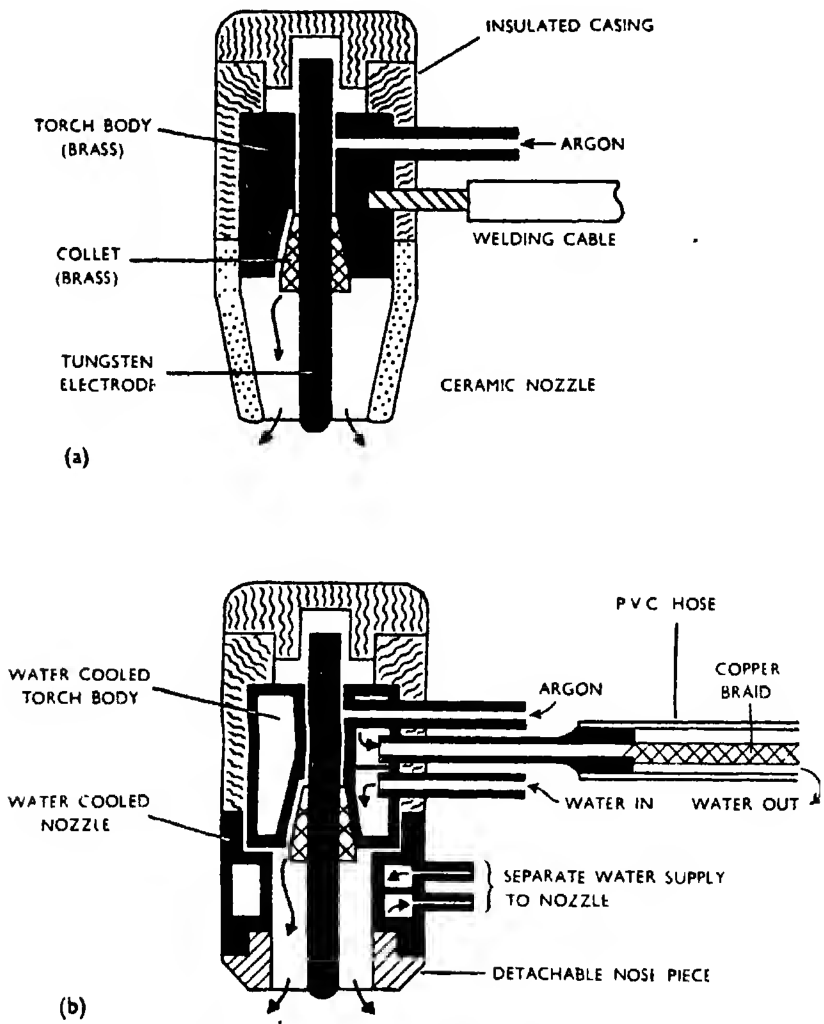


FIGURE 6. *Argon arc welding torches*
(*a*) *air-cooled;* (*b*) *water-cooled*

The argon flow required depends on many factors such as the welding current, size of nozzle, joint design, speed of welding, and the stillness or otherwise of the surrounding atmosphere. For aluminium alloys, a guide to setting the argon flow is five cubic feet per hour, plus five cubic feet per hour for every hundred amperes. Draughty conditions might necessitate having twice this flow. Unprepared butt welds are popular in argon arc welding, since no additional metal need be added, but where the thickness becomes too great for this, then clearly filler metal must be provided. The composition of the filler may be used to control the metallurgical quality of the weld, to prevent cracking or to increase

strength. For example, aluminium magnesium alloys, low in magnesium, are often welded with filler rods having a higher magnesium content, the purpose of which is to give greater resistance to cracking and higher weld strength.

It is very difficult to obtain precise comparisons of the relative cost of argon arc welding and metal arc welding, but arguments on this subject, which were quite prolific in the early days, are of less significance now. For one thing, the argon arc process is cheaper than it used to be owing to considerable reductions in the cost of argon, the chief item of expense, but another reason is that there is seldom a great deal of dispute as to which is the more appropriate method to use. In some cases, metal arc welding is obviously desirable, in others, it is essential to use argon arc welding and the fringe field between the two is a small one. Thus the question of economics does not so often arise as might be expected. It is, however, always desirable that economy should be exercized in the use of argon, and for this reason argon-economizers are fitted which turn off the gas shortly after the current supply is interrupted.

The process is particularly suitable for automatic welding, and there are some quite striking applications. One in particular is the automatic welding of aluminium cable sheaths in which a dual arc is used, and where very long runs must be done with perfection, otherwise valuable lengths of cable would be destroyed. As much as 1,000 yards involving about nine hours of continuous welding has been done without stopping. The process of argon arc welding has considerable application in the manufacture of gas turbines and jet engines, partly because of the difficulty of otherwise welding the materials which are used, but also because it is possible to obtain a very precise control: very highly satisfactory welds are produced which not only look well, but give consistently reliable quality.

Inert gas shielded metal arc welding

Reference was made earlier to the fact that the first method thought of for shielding the weld from the atmosphere was to put a coating on the metal electrode which, when melted and vaporized, provided the shielding gas. It was then some thirty years before the argon arc process was introduced in which a shielding gas was deliberately supplied, and the electrode was non-consumable. After a further interval of five to ten years, these two processes were combined by a most important invention in America. In this, a consumable electrode is used with argon gas-shielding. The process as applied to hand electrodes of the usual type would obviously be difficult to use though, in fact, some attempt has occasionally been made by supplying gas separately through a jet and shrouding the end of the electrode. The new process is one in which the electrode is consumed at a very high rate. It is no longer a stick electrode; it is a coil of wire which is fed through a torch at the end of which it is consumed by the arc. The gas is supplied through the torch in much the same way as with the argon arc torch. This was a highly significant introduction, and gives all the combined advantages of gas shielding with a bare electrode.

Theoretically, the method might be possible with a consumable electrode

[By courtesy of Quasi Arc, Ltd

FIGURE 7. *A self-adjusting arc welding set*

which was fed slowly, and burnt off much in the same way as with ordinary automatic welding, but in fact the invention combined two features—not only the shielding of a bare wire with a separately supplied gas, but also the use of an exceptionally high current density which results in what is known as the self-adjusting characteristic of the arc. The principle of self adjustment depends to a great extent on the power source which supplies the welding current. This means that, although the filler wire electrode is fed at a constant pre-set speed, the welder cannot alter the arc length by moving the torch. An attempt to shorten the arc, for example, is corrected because the shorter arc draws more current from the circuit and this increases the burn-off rate, thereby bringing the arc back to its equilibrium length.

The introduction of the process in America was of the very greatest significance, and machines have now been produced in this country also for a few years. The process is described by various trade names, such as Aircomatic welding, Sigma welding, Argonaut welding, but a generic term which is more suitable, is self-adjusting arc welding. Figure 7 shows the general arrangement of the equipment; the wire is provided on a drum and is fed through a pair of driving rolls which force it at a speed of up to 500 inches per minute, through a flexible tube to the nozzle. This tube may also carry the power supply and the shielding gas. Everything terminates in the nozzle operated by the welder, and the process of operation is a particularly simple one which can be learnt far more easily than ordinary metal arc welding.

The process is used for the welding of light alloys, stainless steel, a number of other non-ferrous alloys, and has recently been applied to the welding of mild

steel, an illustration of which is shown in Figure 8. Whilst in the early days of the process argon was the sole shielding gas used, there have now been various modifications in which argon is mixed with oxygen, and sometimes carbon dioxide is used, according to the type of material being welded. The prospects for this equipment in the future are very large; it is becoming increasingly popular, and undoubtedly leads to good quality welding at a much higher rate than is possible with any other method. It should be said, however, that to get the best results it is desirable that special types of power source should be used for the purpose, and extensive co-operative research work between the Electrical Research Association and the British Welding Research Association has led to recommendations involving power sources of quite different characteristics from those generally used for metal arc welding. These characteristics are such as to reduce the open circuit voltage, and to lead to much greater stability in welding.

Naturally, commercial developments follow slowly on research, but it is quite evident that the introduction of this new process has led to new and quite original thought on the types of power source required for welding circuits, and it may well be anticipated that not only will this lead to changes in the type of power supply used for the self-adjusting arc welding, but may well react on the type used for other kinds of welding.

It would be unwise, indeed incorrect, to suggest that this new method of welding is substantially displacing metal arc welding. This simple and relatively cheap method of welding is likely to be the principal method used for very many years in the future, but there is no doubt that the introduction of self-adjusting

[By courtesy of Morfax Ltd and Scope

FIGURE 8. *Welding a mild steel structure by the self-adjusting arc process*

arc welding has great possibilities, and is steadily finding increasing use. At the moment, the cost of equipment is high, and the method is perhaps only justified where high production rates are required. There is undoubtedly much development work yet to be done, particularly in the direction of improving the quality of the welds which are somewhat liable to porosity, but the process should be watched by all interested, very carefully, for there is little doubt that this introduction is quite as important in the welding field as was the introduction early in the century of covered electrodes to replace bare wire.

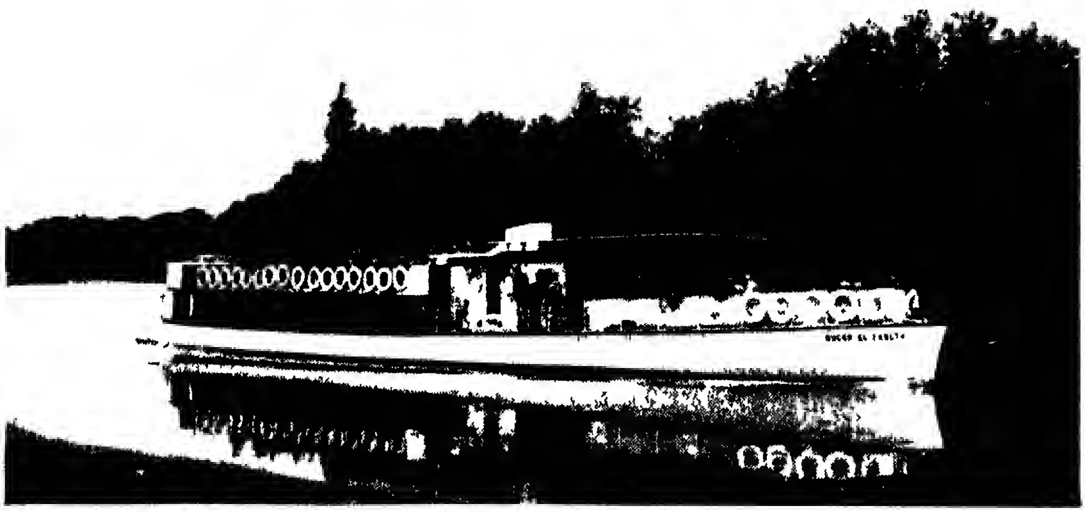


FIGURE 9. *The* Queen Elizabeth*—aluminium superstructure welded by the self-adjusting arc process*

The process is particularly suitable for aluminium, and it is interesting to record that the first large-scale application to this material in this country was done by the British Welding Research Association when the superstructure for a small Thames pleasure-cruiser was welded in the open air, using the self-adjusting arc process. This was done in the year 1952, and was entirely satisfactory (Figure 9). Since then, the process has been used on another and much larger vessel, the *Morag Mohr*, which is a yacht of 45 tons displacement, fabricated from aluminium magnesium alloy. There is a steadily increasing interest in the use of aluminium for the superstructures of ships, and there is little doubt that, where the weather conditions are not too unfavourable, this new method of self-adjusting arc welding has considerable application.

There is at present under construction in a British yard a 20,000 ton liner for Norway, the *Bergensfjord*, where this method has been widely used for the aluminium superstructure. This structure contains 300 tons of aluminium alloy, and both hand and controlled arc welding are being used. Fillet welds have been made at the very high speed of eight feet per minute. The *Manicouagen* is another vessel having a welded aluminium superstructure which has been recently built in this country.

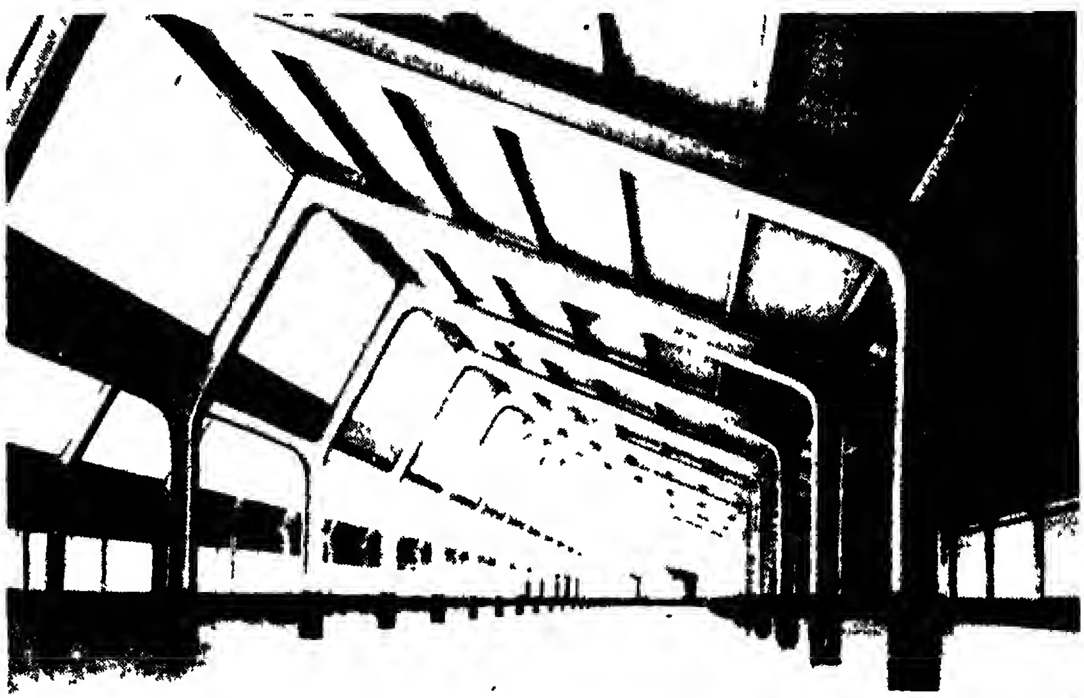
LECTURE II

Monday, 23rd April, 1956

APPLICATIONS OF WELDING

Structural steelwork

One of the most important applications of welding, and one which has made very great strides since the war, is the application to structural steelwork. This includes bridges, buildings, tanks of various kinds, cranes, and other types of construction. In the case of buildings, welding is particularly applicable to factories, where a very great improvement in appearance can be effected by using welding in the place of riveting (Figure 10). The clean lines which arise from a welded structure are quite striking and immediately apparent on entering a factory; not only is this an advantage from the point of view of appearance, but it means cheaper maintenance, since cleaning and painting are made less costly by the absence of rivet heads. Also there is less dust and moisture on the steelwork, because of the smoother surfaces, and corrosion problems are minimized. Most important of all is the fact that, with the use of welding, considerable economy can be effected in the weight of steel used, which is important in times of steel shortage, but this can also result in a reduction in cost, though, in fact, there was some difficulty in the early days due to some contractors placing a higher price on welding construction than on riveting construction, just because they were inexperienced and wished to continue in the old way.



[By courtesy of Murex Welding Processes Ltd.

FIGURE 10. *Welded steel frame factory building; Austins, Cleveland, Ohio*

One other advantage of welded construction is that construction is a very much more silent operation than with a riveted building, and for this reason extensions to hospitals may advantageously be welded. It is interesting to note that the rapid extension of office and factory buildings in Houston, Texas, has been done by welding, largely to minimize the noise nuisance.

A typical example of a welded factory building is that of the new mill building for Bairnswear Limited, Worksop. The framework is of continuous monitor form, designed as a portal frame structure consisting of three sixty-foot spans with the outside legs of the frames pinned at their bases. The overall width of the building is 180 feet with a length of 380 feet: maximum height from the floor level to the general roof is 21 feet.

Another example of welded structures is the I.C.I. Tube Mills of Kirkby. This all-welded single-storey factory building comprises two bays, ninety feet wide and 1,500 feet long, with a clear height to the eaves of thirty feet. Adjacent is a single-storey flat roof bay, thirty feet wide and 18 feet high, running almost the full length of the main building. The total weight of steelwork amounts to 4,000 tons. The main frames of the double bay building at thirty-foot centres are completely welded. The vertical legs are 30-inch by 12-inch H sections; each is built up from a 20-inch by 12-inch broad flange beam with a 10-inch by ⅝-inch plate inserted in the centre of the web. The rafters also of H section have a profile tapering from 25 inches deep at the bottom of the roof slope to 14 inches deep at the ridge. These are also made up from a 20-inch by 12-inch broad flange beam section in which the webs are cut diagonally, the pieces reversed, and the webs butt-welded together. An early example of the use of welding in constructional work in this country was the reconstruction of the Bank of England where, no doubt, the merit of silence of construction was a feature which influenced the decision to use welding. The city of Toronto now claims to have the world's largest all-welded steel frame building. Over 5,000 tons of fabricated steel were used in the structure, and ultrasonics were used to determine the soundness of welds. No less than ten tons of welding electrodes were consumed on the job. The building was designed with four column rigid frames with all beam joints welded. The building was erected for the Imperial Oil Ltd., and possesses a floor area of nearly 300,000 square feet. It is 290 feet high.

As is well known, in all constructional work the cost of the job increases with the elevation above ground level, not only because of the problem of transporting things to greater heights, but also the additional danger to which men are exposed involves greater care and slower work. For this reason, there is considerable interest in the method used to erect airport hangars at Madrid. The whole roof was constructed on the ground, and then lifted into position. This method of construction has been used a number of times in Spain, and has considerable merit. One of the hangars is 154 feet wide and nearly 600 feet long. The total weight of the roof is 450 tons, which represents no mean achievement in erection practice.

It had long been suspected that the rule-of-thumb methods used for the

design of steel frameworks were based on assumptions very far from the truth. The need to investigate the position led to the setting up of the Steels Structure Research Committee in 1930, and for many years careful research was carried out to discover the true situation. Experiments were made on the Cumberland Hotel and on the Geological Museum whilst the buildings were under construction, and they confirmed the suspicions that assumptions were far from the truth. Arising from all this work, a rational method of design in the elastic range was devised but, unfortunately, it was somewhat difficult to apply, and whilst it was in fact rational and led to the stiffening up of some members and to reducing the dimensions of others, the final result did not represent a very great economy in steel. As a result, the industry stuck to its old methods and, to some extent, the work of seven years' research was virtually thrown away. However, the principal investigator, Professor J. F. Baker, then turned his attention to a much more profitable line of research, namely, a study of the behaviour of structures when the steel is stressed into the plastic range. The old method of design was based on the assumption that the maximum stress at any point in the framework did not exceed the yield point of the material. The plastic design method is based on the assumption that at some multiple of the maximum working load on the building the structure will completely collapse. This is, after all, a much more rational approach than the old method, and it is a method which leads to appreciable economy. Plastic design, which is the name by which the method is known, is only applicable to truly rigid structures, that is structures which are made by welding. It is also important to note that structures which were indeterminate by elastic methods of design can be completely solved by plastic design methods and all the members therefore economically dimensioned.

Professor Baker has been working at Cambridge with a team of assistants on this subject for about ten years with the support of the British Welding Research Association, which naturally has considerable interest in such a method of design. Full-scale experiments which have been conducted have, in fact, been carried out at the Association's own Research Station at Abington. It was perhaps inevitable that the acceptance of such a revolutionary method of design has proved to be somewhat slow. There is, however, considerable interest and, in the last two or three years, practical application is by no means negligible. In fact to-day there are something like 200 buildings, or even more, which have been constructed using the plastic design method. There is still much research to be done, particularly on multi-storey buildings, in order that the ultimate efficiency may be achieved, but in general terms it may be said that by the use of plastic design up to as much as 25 per cent of the weight of the steelwork may be saved, as compared with normal riveted construction. It is interesting to record that, although this research work has been consistently published, it has so far not been applied in the United States to anything like the extent that it has been in this country. Americans admit our leadership in this field, both in the theory of the method and in its practical application. One of the first buildings in this country to be constructed by this method was the Fatigue

Laboratory of the British Welding Research Association at Abington, near Cambridge. This building was erected in 1952.

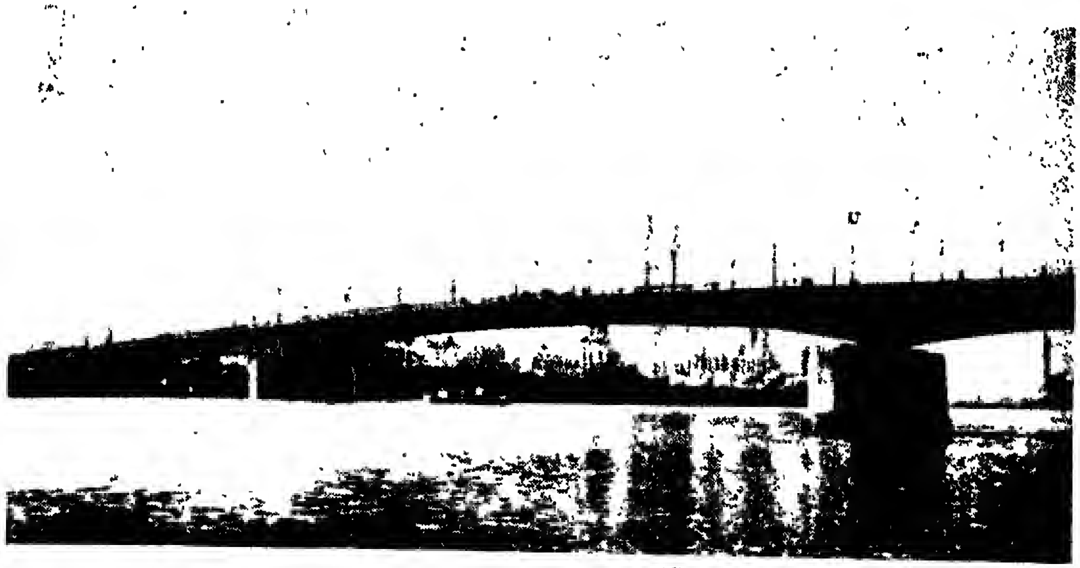
An important application of this method of design is to the stores buildings for the Admiralty which have been erected at Rosyth and elsewhere. Another important building is the transit shed for passengers and cargo at Southampton which was also designed by the plastic method.

Welding is also being used in the construction of frameworks for some of the new power stations built by the Central Electricity Authority. For these stations very heavy steelwork is required, since not only is it necessary to support cranes capable of lifting the heaviest parts of machinery, but also it is the practice to-day to hang the boilers from large girders, as distinct from the old practice which was to stand them on the floor. This extra heavy type of construction has led to the introduction of rectangular box section stanchions as the main supports. These stanchions, which are built up from flat plates which are several inches thick, are made by welding the plates together at the corners. Automatic welding is naturally used for such a purpose. Box section portal frames, built up from plates, are also being used for the turbine house. The clean lines and smooth surfaces with this type of construction not only give a pleasing effect, but also reduce the maintenance costs.

A big advance in welded structures was made a few years ago when it was decided to use welding for the structural work of the various shops of the Margam Steelworks. The smallest of the three operational shops was the mould preparation bay: this is 97 feet wide and 880 feet long, and has continuous welded crane girders for the full length. The melting shop had the heaviest crane girders. These were 110 feet long between supports—to suit the spacing between steel furnaces—and 12 feet 9 inches deep to suit the 300-ton capacity cranes on the casting bay side. The flange plates varied from 36 inches by 2½ inches to 36 inches by 4 inches, and were welded to flitch plates 2 inches to 3 inches thick and 19 to 24 inches deep. The flitch plates were welded to a one-inch thick web plate. The complete girder weighed slightly under a ton per foot of length. The joining of girders to one another was carried out by five welders working simultaneously, and the average time required to complete a joint was 37 man-hours, working continuously.

Bridges

The use of welding for bridges is all-important, and has made greater progress on the Continent than in this country. Some very fine examples can be named as, for example, the Duisberg all-welded by-pass road bridge. This is made up of three spans of 130 feet each, and four centre spans of 33 feet and 44 feet. Another example is the Rugendamm Railway Bridge. This consists of 12 spans of 202 feet long, five spans of 177 feet and five spans of 170 feet. The longest spans weigh just over 100 tons each. Other examples are the Schooten Bridge over the Albert Canal, Belgium, and the Pilsen Bridge, Czechoslovakia. It is interesting to note in this case that the tender for the welded bridge was accepted in competition with several tenders for riveted alternatives, because of the

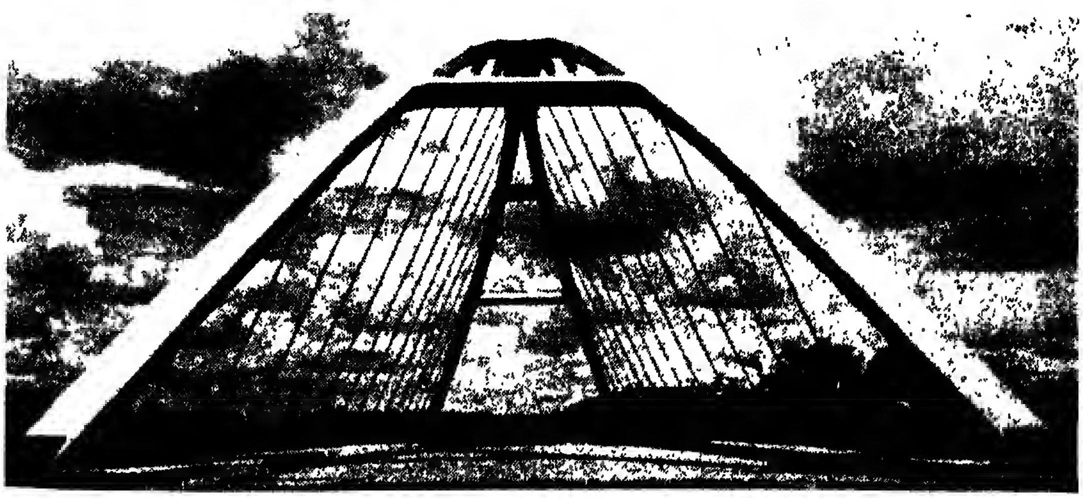


(By courtesy of Murex Welding Processes, Ltd.

FIGURE 11. *Welded bridge over the Rhine at Cologne*

lighter weight and lower cost of the welded design. Very considerable use of welding for bridges was made by the Germans in the construction of foot bridges and road bridges over their *Autobahnen*. A fine example of welding is the new Cologne Bridge over the Rhine (Figure 11). This bridge is 68 feet wide, made up of a 38-foot roadway having two tram tracks, two cycle tracks of five feet each, and two pavements of ten feet each. The total span of the bridge is 1,434 feet over two piers: the lengths of the individual spans being 433 feet and 397 feet for the shore spans, and 604 feet for the central span. The shore span slopes towards the centre at 2·8 per cent. The total weight of the bridge is 5,669 tons. It replaced an old suspension bridge weighing over 8,000 tons.

An interesting example from America is the bridge over the Rio Blanco near Vera Cruz (Figure 12). The interesting feature about this bridge is that



(By courtesy of Murex Welding Processes Ltd.

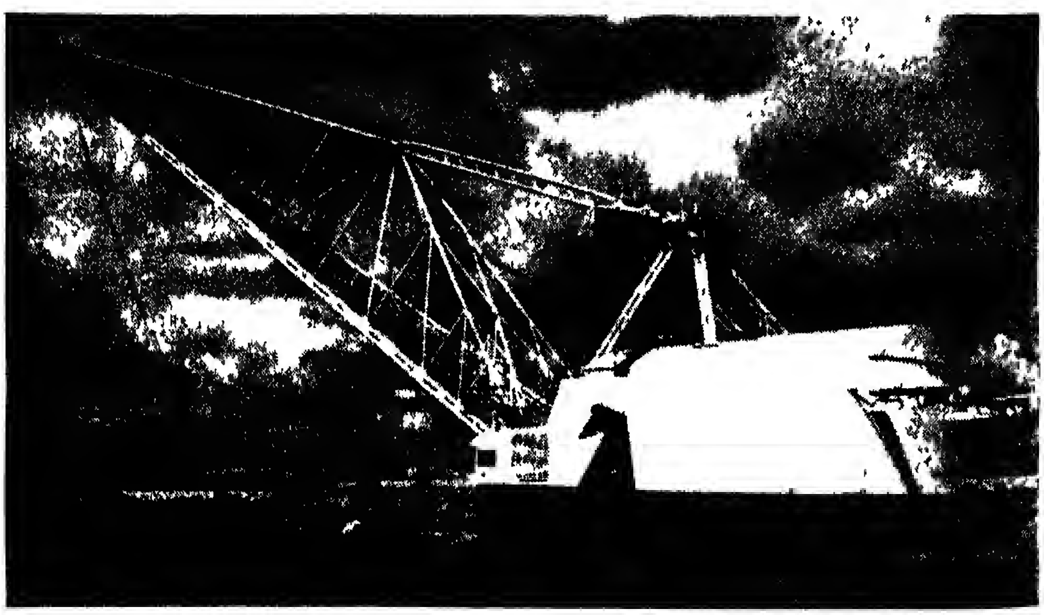
FIGURE 12. *Welded bridge over the Rio Blanco, Vera Cruz*

the design—which is quite unusual—was the winning entry for a competition arranged by the Lincoln Electric Welding Company, and was subsequently actually used for the crossing of the Rio Blanco. The span is 250 feet, and a splayed arch is used. There is provision for three lines of traffic and two pavements. The two main ribs are inclined towards one another, and merge at the crown over a length of approximately 32 feet. The vertical centre rise is 52 feet. Economies inherent in the arch and diagonal grid floor system made possible weight reductions amounting to as much as thirty per cent of the steel tonnage, and also about twenty per cent reduction in cost in comparison with more conventional bridge designs.

Many welded bridges have also been constructed in this country—typical recent examples being the Stewarts Road Railway Bridge and the Twickenham fly-over. Other interesting cases are the seven bridges, all between sixty and seventy feet long, built to replace others washed away by flooding of the River Eye in Berwickshire in 1948. Contractors were invited to submit tenders for either riveted or welded bridges. Of the six tenders received, all the main items showed a lower cost per ton of steelwork for the welded design than for the riveted design. As, in addition, the former was about twenty per cent lighter than the latter, the choice was simple. The cost saving for one of the bridges by using welding was 16 per cent and, for the remaining six, 27 per cent.

Tubular steelwork

An interesting and important modern development is the use of welded tubular construction. An application which has become very well known is the jib of the biggest walking drag-line in the world. This was built for Messrs. Stewarts & Lloyds, and is used at one of their iron ore mines for removing the 100 feet thickness of overburden below which the iron ore is buried (Figure 13).

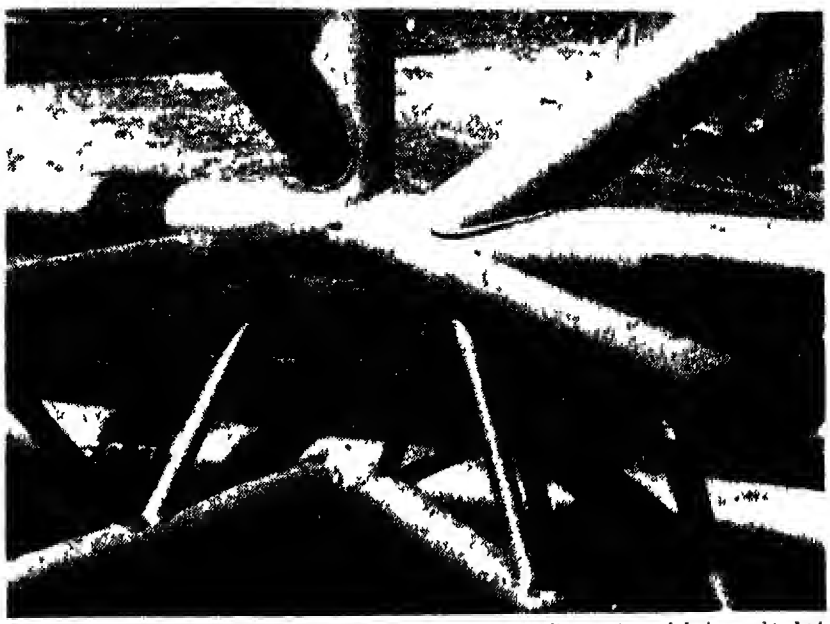


[By courtesy of Tubewrights Ltd

FIGURE 13. *The world's largest walking drag-line excavator*

The jib is made entirely from tubes welded together. The complete excavator weighs 1,600 tons, and the jib is 282 feet long. In its working position, its head is five feet higher from the ground than Nelson's column. The drag bucket, which is also fully welded, weighs 26 tons and has a capacity of twenty cubic yards of earth—weighing approximately 27 tons. Thus the total load on the jib is over fifty tons, and this is slewed at a radius of 260 feet—nearly the length of a football pitch. The jib itself weighs 126 tons.

The two main boom members were made from twin tubes with distance pieces welded in. By this means it was possible to adjust the size of the tube to suit the stress, and to change from one size to another by means of taper tubes. The maximum diameter of tube used in the booms was 16 inches. The material for the tubes was a low alloy chromium-molybdenum steel, and a half per cent molybdenum steel electrode was used for welding. No less than two tons of electrodes were required, numbering some 18,000, and two men did all the welding. All critical welds were inspected radiographically, and a few defects were found and rectified.



[By courtesy of Tubewrights Ltd

FIGURE 14. *Complicated tube intersections on excavator jib*

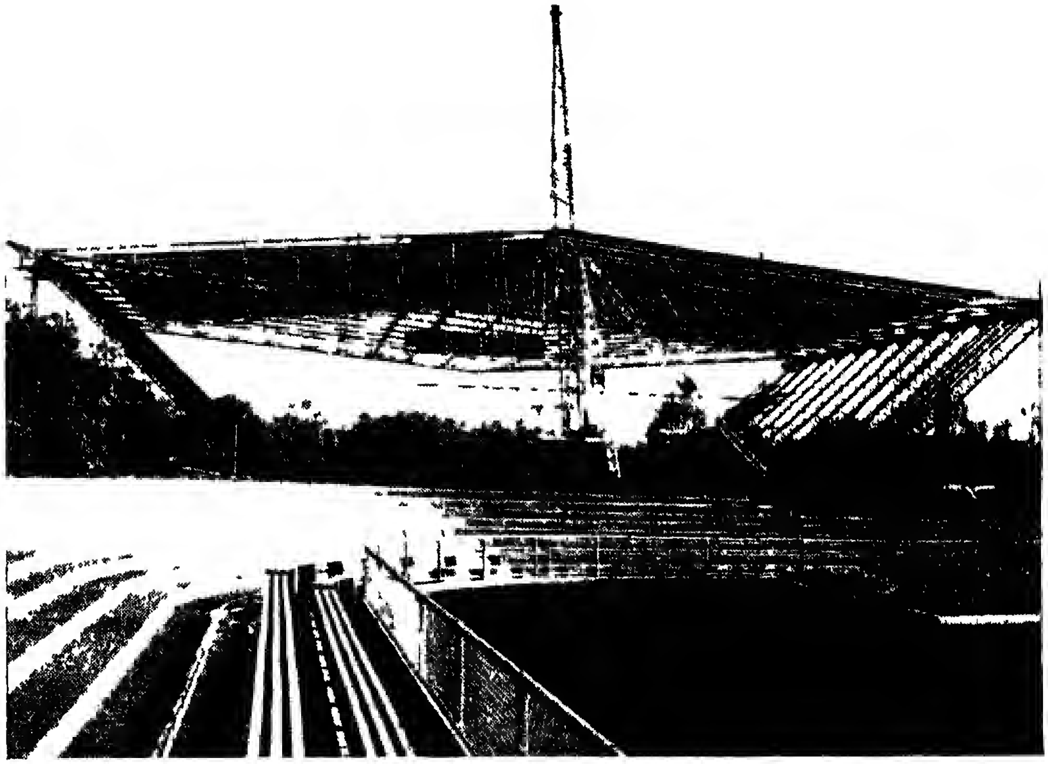
Pre-heating to 160°C. was used for all welds, and owing to the adverse conditions which sometimes occurred when doing this work in the open air, asbestos blankets were used around the weld and placed over the weld to slow the cooling rate. Great skill was required in the preparation of the tubes to ensure the correct angle between the surfaces to be welded together. The joining of tubes by butt and fillet welds always requires special care, but the complication of this job was exceptional because in many places several tubes of different sizes meet at a point—and all are highly stressed (Figure 14). This situation seldom arises in pressure pipework where, although the angles may present similar preparation difficulties, it is seldom that more than two pipes meet at a point.

Another outstanding modern achievement, made possible by welding and the use of tubes, is the National Coal Board sea boring unit (Figure 15). This is a structure which makes it possible to bore trial holes below the sea in order to search for coal seams—many of which surround the coast. The unit was built on the shore and floated into place on pontoons. It can be moved from one site to another, and is completely self-contained with power supply, drilling gear, lifting tackle and living accommodation comprising no less than 25 bedrooms (all with hot and cold water supplies), mess rooms, a cooks' galley, and other amenities.

By courtesy of Tubewrights Ltd

FIGURE 15. *National Coal Board sea-boring unit—welded tubular construction*

A special feature of this construction is once again the multi-branch connections of which there are 24, where from four to ten tubes meet and are welded together. In some cases, the tubes have to be tapered to fit into the cluster. In the case of the sea boring unit, it was possible to do much of the difficult welding in the works since the unit had to be demountable so that it could be transferred to a distant site if necessary. Tubes up to 24 inches in diameter are used. The tower is designed for boring in a sea-way up to a depth of 120 feet, and can withstand an eighty mile an hour gale and thirty-foot waves. It is an exceptional British engineering achievement worthy to take its place beside the Forth Bridge near to which it was built and first used.



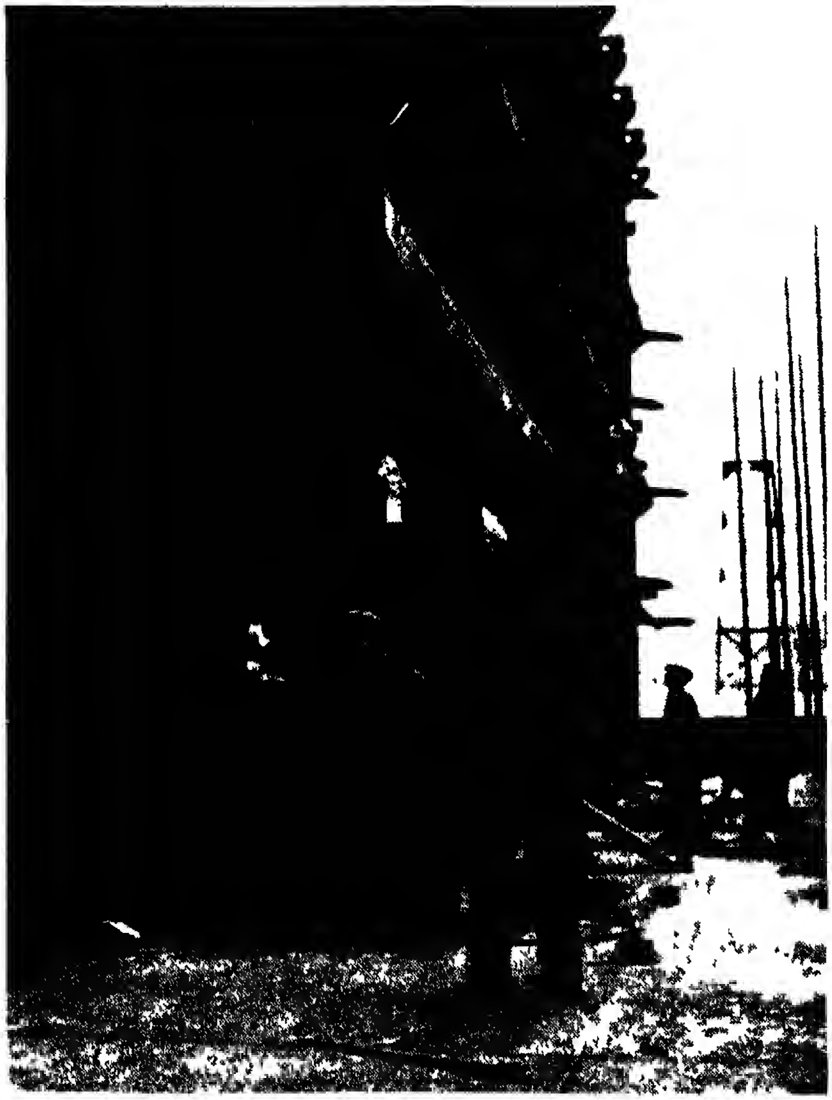
By courtesy of Tubewrights Ltd

FIGURE 16 *Olympic swimming pool, Melbourne. Welded tubular steel construction*

Another interesting application of welded tubular structure is the swimming pool specially constructed for the Olympic games at Melbourne (Figure 16),

In all kinds of transport, whether by road, rail, air or sea, welding fulfils an important *rôle*. In the case of cars, resistance welding is mostly used, but there is also some application of gas welding. In the case of lorries, some arc welding is used, and particularly for road tankers. These are used for conveying all sorts of liquids such as milk, beer, petrol and chemicals, and the vessels are to-day invariably welded. With aircraft, so far as the frames are concerned, welding is mostly of the resistance type. Arc welding of various kinds is, however, used in connection with the engines.

The most important application of welding in connection with transport is the welding of ships. In 1918 a 275-ton welded barge was constructed in this country for cross-channel service. This was the first use of welding in the construction of a sea-going vessel. The hull was rectangular in cross section amidships with only bilge plates curved. Plating was $\frac{1}{4}$ inch and $\frac{5}{16}$ inch thick, and all the joints were lap welded. At the time, this was generally thought to be the first application of welding to a vessel, but it was subsequently revealed that a welded boat had been in use on Lake Erie for a number of years. This was called the *Dorothy M. Geary*, and was built by its owner, Mr. Frank Geary of the Geary Boiler Works, Ashtabula, Ohio. The keel frames and deck house



[By courtesy of Shell Photographic Unit

FIGURE 17 *A 17-ton pre-fabricated section bulkhead being lowered into place on a tanker*

of this boat were riveted, but the seams of the hull and the fore and aft deck plates were all electrically butt welded. The coaster *Fullagar* was the first all-welded ship to be built under Lloyd's survey. She had a dead weight of 500 tons, was built by Cammell, Lairds, at Birkenhead, and launched in 1920.

Since these early efforts, the use of welding in connection with ships has increased enormously. To-day all the large oil tankers are completely welded, and considerable use is made of welding with passenger ships and also with naval vessels. During the war, the opportunity was taken of using labour unskilled in shipbuilding for the construction of small vessels known as 'tids'. These were tugs of seventy feet length and ten feet breadth, and the parts were made away from the sea and conveyed by trailer to the shipyards where they were joined together and the vessels launched. The same policy was used in connection with

various kinds of landing craft. An important application of welding during the war was in the construction of Liberty ships made in America, and supplied in large numbers to make up the shipping losses which were suffered through submarine activities. These ships were all welded, using, in many cases, substantially unskilled labour. Some troubles were experienced with brittle fracture, but the service rendered to the Allied cause by the construction of these ships at very high speed was quite invaluable.

Oil tankers are all welded and the largest afloat to-day is the British-built 47,000 ton *Spyros Niarchos* due for delivery in May this year. This ship is 757 feet long, 97 feet beam and 52 feet deep. The largest all-welded passenger liner—the *Orsova*—belonging to the Orient Fleet, has also recently been built in this country. She has a gross tonnage of 28,870 tons, a displacement of 31,810 tons and is 723 feet long.

[*By courtesy of Shell Photographic Unit*

FIGURE 18. *Automatic welding on a tanker*

The introduction of welding has led to the greatly extended use of prefabrication as a method of ship construction. This facilitates the work very greatly, and enables construction to be done away from the actual slipway. It was used extensively during the war, and very large items, weighing up to forty tons or more, can be made separately, and then fitted into place.

Pressure vessels

In no other industry does welding play a greater part than in the construction of pressure vessels. Whether the vessels are required for steam raising, oil refining, or chemical processing, welding is invariably used where the operating conditions are onerous, that is to say, for high temperatures or high pressures, or where both are combined. In the case of high-pressure boilers, the steam drums are themselves sometimes solid forged; riveting is never used to-day, but perhaps most of the steam drums are made by rolling steel plates and butt welding longitudinally with the provision of special ends which are then welded to the cylindrical portion with circumferential butt welds. Subsidiary equipment, such as superheaters, economizers, all pipework, and condensers, are invariably welded also. The tendency to-day of rising temperatures and rising pressures makes it quite certain that welding is the only possible joining method. So far, boiler drums have been made only from mild steel, but increasing consideration has been given to the possibility of using alloy steel in view of the fact that thicknesses are increasing very considerably. Five inches is not an exceptional thickness to-day.

[By courtesy of G. A. Harvey & Co. (London), Ltd

FIGURE 19. *Welded distillation column for an oil refinery*

Inspection of such welded vessels is of paramount importance, and a great deal of attention has been given to this aspect. Hundred per cent radiography is applied, generally using X-rays, though there is an increasing tendency to make use of isotopes and a minimization of the cost could possibly be effected by the use of ultrasonics as a preliminary inspection method. This is, however, as yet only in the experimental stage.

The oil refining industry requires quite spectacular vessels for use as distillation columns, catalytic crackers, and so on. Some of these vessels are quite exceptional in size; they have been constructed to 19 feet (internal) diameter, and as much as 140 feet long, and the weight may approach 150 tons (Figure 19). The vessels are all erected vertically on the site, and in some cases are erected at some considerable height above ground level. Such vessels naturally present considerable transport problems, and if they have to be transported by road, they usually travel at times when traffic is at a minimum. It is also not unusual to seal the vessels, and transport them by water, using tugs. Another problem which is of considerable importance, is the stress relieving of such vessels, for their dimensions exceed the size of any available stress relieving furnaces. In consequence, the vessels can only be stress relieved in sections.

There is quite a substantial business in stainless steel vessels, especially for the chemical industry, and in vessels in which stainless clad and nickel clad mild steel are used. Sometimes the quality of surface required in such vessels is very high indeed, and considerable effort must be expended in polishing. It is not unusual in the chemical vessel industry to have internal mixers in the vessel, and another common form of construction is a jacketted vessel, or again vessels containing heating coils. All these present quite complicated welding problems, not only in the actual execution, but also in ensuring satisfactory inspection up to the required standards.

The welding of the cylindrical pressure vessels, referred to above, is usually done by automatic welding units, either of the covered electrode, or submerged arc type. In the former case, a current of the order of 1,000 amps is used, and in the latter case, anything from 2,000 amps upwards. The welding heads are generally mounted on a travelling cantilever wall crane or other type of equipment, and for doing the circumferential seams, the work is rotated on rollers. In the case of internal welds, the welding head must be supported on a long arm, which is of sufficient length to reach from one end of the vessel to the other. An alternative arrangement which is sometimes used is to lay rails inside the vessel, and traverse the welding head on these.

The problem of devising the most economical method of joining nozzles to pressure vessels is one which has been given considerable attention by the British Welding Research Association. In the past it has been the practice to fit a collar reinforcement around the pipe or nozzle, but there has been no scientific basis for determining the size of this. It has been discovered in the course of research work that it is much cheaper and more effective to project the nozzle or pipe slightly into the vessel, and to eliminate the use of a patch reinforcement. This projection inwards gives additional strength and its only objection appears to be that if the nozzle is in the bottom of the vessel, it is not possible completely to drain the vessel. As a result of recent researches, the Association is of the opinion that as the thickness of vessels increases, the importance of the reinforcement becomes less. Investigations have not yet been completed, but it is hoped that, as a result of this work, it will be possible considerably to economize in the cost of welded nozzles.

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FIGURE 20. *8 ft. by 8 ft. R.A.E. wind tunnel at Bedford*

Wind tunnels

The problems of constructing wind tunnels for the aircraft industry are somewhat analogous to those of pressure vessels. The largest of these has been built for the Royal Aircraft Establishment, and it will be well appreciated that modern requirements of high Mach numbers require very special equipment indeed. Welding plays a prominent part in the construction of wind tunnels.

Such an installation is the 8-foot by 8-foot high-speed wind tunnel of the Royal Aeronautical Establishment, Bedford, which is shown in Figure 20 in the course of erection. It is interesting to note that the plates for this tunnel are from $\frac{13}{16}$ of an inch to $1\frac{3}{8}$ inches thick, and were made from a steel with a controlled Charpy impact value of 35 feet/lbs. at $-10°$C. The object of this requirement is to minimize the risk of brittle fracture. Nearly 5,000 tons of steel were used in the pressure shell which has a maximum diameter of 47 feet. The tunnel is of the closed circuit type 350 feet long between centres, and eighty feet long between short centres. All the welds in the tunnel were 100 per cent X-rayed to Lloyd's Class I Standard.

Of particular interest from the welding point of view are the flexible guide plates and the diaphragm plates. The former are about eighty feet long and are stiffened with a large number of welded-on T-sections. All the welds were examined by X-rays. The latter are 47 feet in diameter and $2\frac{1}{2}$ inches thick, and through each of them pass no less than 58,000–$1\frac{1}{2}$ inches diameter tubes. These are resistance welded tubes, expanded and welded into the tube plates at $1\frac{3}{4}$ inches triangular spacing. The tubes form part of the cooler which is

required to reduce the temperature of 1,200 lbs. of air per second from 160°C. to 50°C. The air leaving the cooler is to have a uniform velocity and temperature which is to be controlled within ± 1°C. In the whole structure of the wind tunnel there were 16,000 feet, that is rather more than three miles, of welding and of this less than three per cent was cut out for defects and re-welded. These defects were mainly due to porosity or slag inclusions; cracks in welds or in the parent plates were quite unusual. In order to avoid the possibility of brittle fracture, day and night temperatures during erection were continuously recorded, and welding operations were stopped when the air temperature dropped to 2°C. or below. The radiographic examination of the welded seams, and the interpretation thereof, was a continuous process, since it was obviously desirable that the inspection should follow welding as quickly as possible. In fact, it was usually from fifty to 150 feet of seam behind the welding. Thus the correction of defects was not long delayed.

The magnitude of this enterprise may perhaps be appreciated from the fact that 2¼ million gallons of water were required for the water test, which was carried out at a mean pressure of 67½ lbs./square inch, which is 1½ times the working pressure of the tunnel. With such a large container and such a relatively small pressure, it is obvious that the effect of the head of water must be taken into account. This means, in fact, that when the mean pressure is 67½ lbs., the minimum pressure is 57½ and the maximum pressure at the bottom of the vessel 77½ lbs. In this case, it was possible to make a water test, but it will be appreciated that had this vessel been erected on end, for example, a water pressure test would have been quite impossible, for the head of water would have caused much too high a pressure at the bottom. Moreover, the problem of supporting such a weight of water is quite considerable; even in the horizontal position special supports had to be supplied. Other types of welded vessels than wind tunnels sometimes present similar testing problems from this point of view, and the only solution is to use air, but the risk of so doing is quite considerable.

Oil Refining

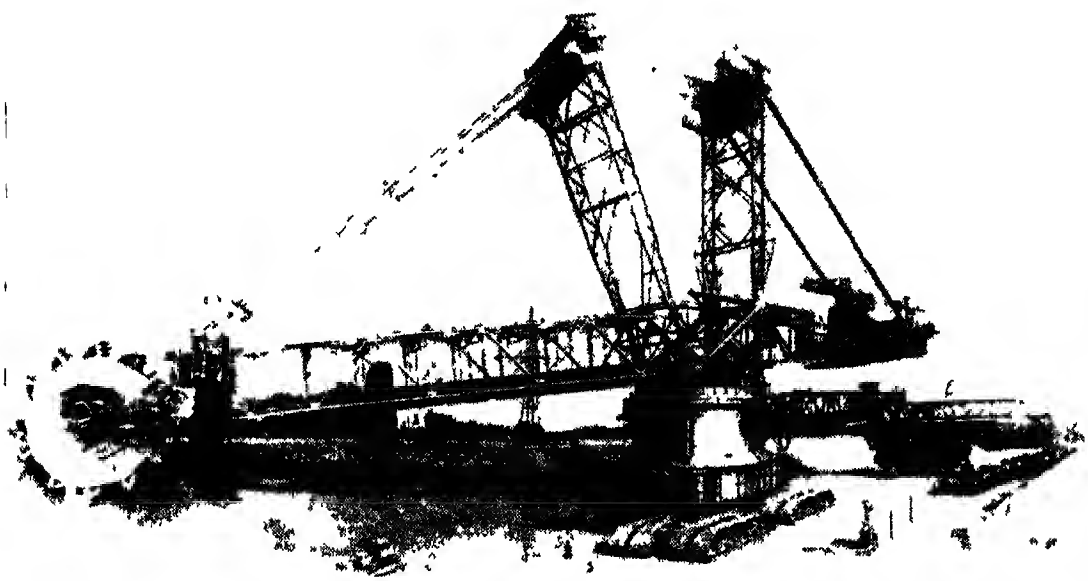
Reference has already been made to the extensive use made by the oil industry of welded pressure vessels. These range from relatively thin vessels which are up to twenty feet in diameter, and 140 feet long, to smaller vessels suitable for very high pressures and temperatures where the corrosion conditions require specially resistant materials which may present welding problems. High pressure welded vessels working at very low temperatures are also used. For oil storage, the industry makes large use of all-welded tanks which may have fixed or floating roofs. These tanks are made from mild steel with special provision where the plate is thick to guard against brittle fracture. Hand welding is generally used, but an automatic process has recently been used in America for the horizontal seams.

Overland pipelines are also welded at the circumferential seams on site, and there are many thousands of miles of such pipeline in existence. There is increasing interest also in such lines for long distance gas distribution in this

country; in the United States overland oil gas distribution is, of course, well known.

Excavators

The drag line excavator used in removing overburden at iron ore quarries has been described. Its size can be matched by an unusual brown coal excavator produced in Germany. This is of the bucket wheel type, and considerable use is made of welding (Figure 21). There are 12 buckets, entirely welded, on the bucket wheel and each bucket has a capacity of 4·6 cubic yards. The wheel is 52 feet in diameter. The overall length of the excavator, including the loading gear, is 220 yards, and it can excavate 10,000 cubic yards of loose material per hour. This corresponds to nearly a quarter of a million tons in three eight-hour shifts.



[By courtesy of Orenstein Koppel und Lübecker Maschinenbau A.G.

FIGURE 21. *Bucket wheel excavator for brown coal*

With such a duty cycle, the welding must be of the highest quality to stand the dynamic loading conditions on the buckets, and there is no doubt a substantial repair problem in maintaining by welding the hard surfaces on the bucket teeth.

Atomic Energy

During the course of this lecture, we have shown the increasing importance which welding is playing in industry to-day. In transport, in pressure vessels, in the oil refining industry, in general engineering and in many other aspects but none exceeds in importance the most outstanding development of the

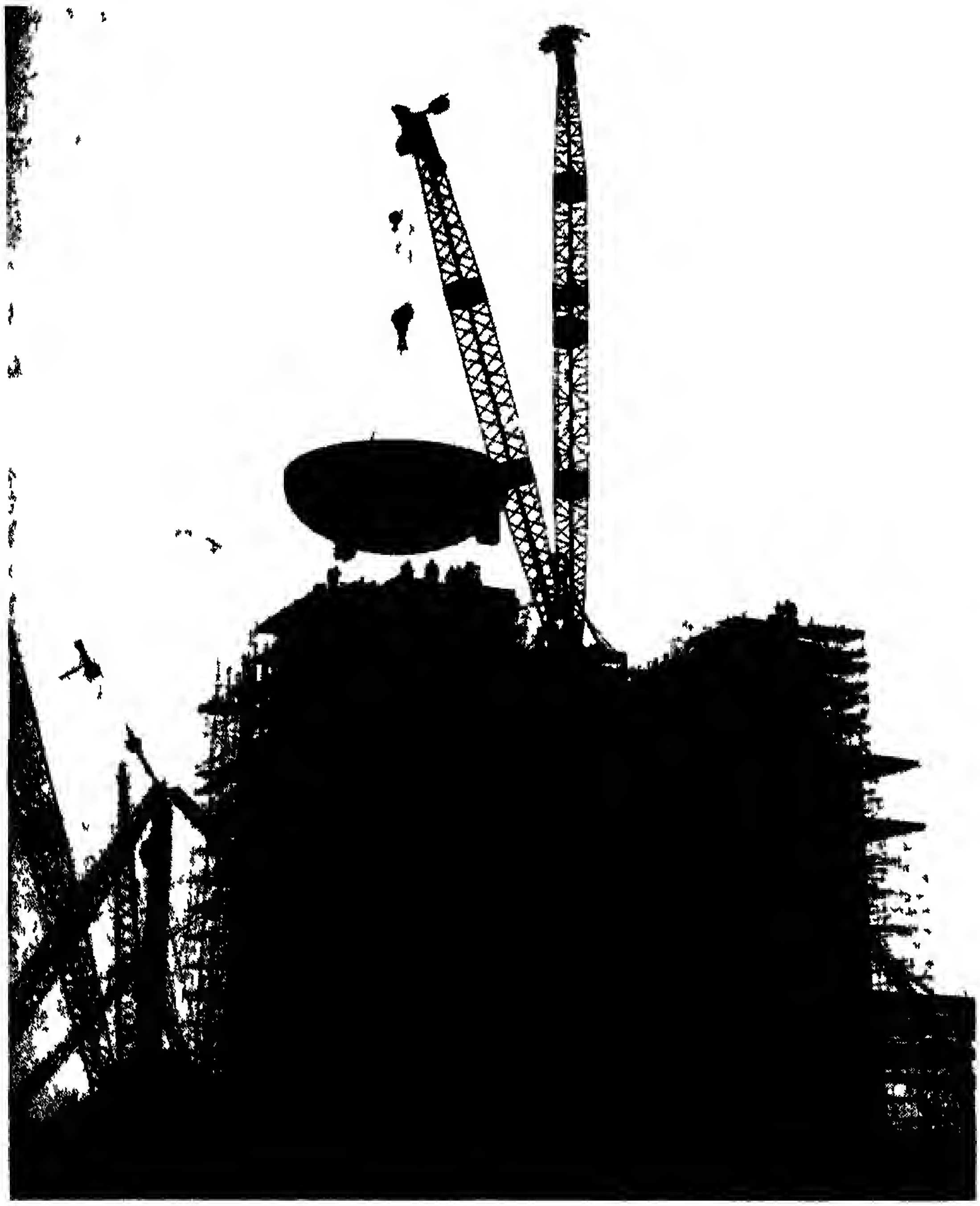
twentieth century, namely, the application of atomic power. Developments in this field would have been virtually impossible without the use of welding. The requirements are so stringent, quite different from anything which has been required before, that they could not possibly have been met unless welding had developed to its present high pitch of excellence. Naturally, much of the equipment which is used, and details of methods of construction, are confidential, but a good deal of general information is available, and reference might first be made to the chemical engineering plant which is used by the Atomic Energy Authority. This comprises vessels of all kinds and descriptions, mainly in mild steel, light alloy, and stainless steel. With stainless steel, a choice was made in the early days of a type of steel which presented particular welding difficulties. These, however, have been overcome, as have other welding problems in matters relating to atomic energy.

Amongst the various materials used in the construction of the Atomic Energy Authority factories, are many miles of large diameter aluminium pipe, which in certain cases have been joined by welding to a high degree of vacuum tightness. Resistance to leakage is of the very highest importance, and exceptional care is, therefore, taken over leak testing, but an industry which has acquired the art of welding vessels up to very high pressures which are completely reliable, did not find very great difficulty in making other vessels capable of standing atmospheric pressure indefinitely. It is generally known that much of the equipment which is used by the Atomic Energy Authority can virtually never be inspected. It is, therefore, essential that the welding should be of the highest quality, and very great care is taken with non-destructive testing.

Coming now to specific applications, reference may be made to the Calder Hall atomic power station. Basically, this consists of two very large all-welded reactor vessels contained in concrete buildings some 120 feet high. Outside each building are four heat exchangers which are the boilers of the power station. Through these steam generators, passes the high temperature high pressure carbon-dioxide from the atomic reactor. The heat of the carbon-dioxide is passed through the heat exchanger to the water and steam for the normal low pressure steam turbines. These steam generators were made from Coltuf steel and are 17 feet 6 inches in diameter by eighty feet high and 1·3 inches thick, the ends being 1¾ inches thick. They were made up in a series of rings at the contractor's works; these rings were then shipped in halves to the site, and joined together and joined to one another at the site of Calder Hall. As is usual with pressure vessels, stress relieving was necessary, and this was carried out on site by induction heating—an exceptional job done in an unusual way. Each of the reactor's four steam generators contains tubes with 10 million studs welded on them, the purpose of which is to increase the area of the tubes exposed to the hot carbon-dioxide gas. Flash-butt welding is used for attaching the studs which are eliptical in section, and measure about ⅓ inch by ⅛ inch. They are flash welded at the rate of 1,000 to 1,500 per hour per man per machine, but even at this high rate, many months and many flash welding machines are required for the forty million studs required for each reactor.

The empty shell of each heat exchanger for each reactor at Calder Hall weighed 180 tons, and after tubing each weighed 550 tons. Exceptional cleanliness requirements inside the vessels had to be met—studded tubes, men and tools, all had to enter through a temporary intermediate chamber used as a dust trap and for controlling the humidity of the air in the heat exchanger.

The reactor vessel is much larger than the heat exchangers and is made up entirely from shaped plates It is about 35 feet in diameter and seventy feet

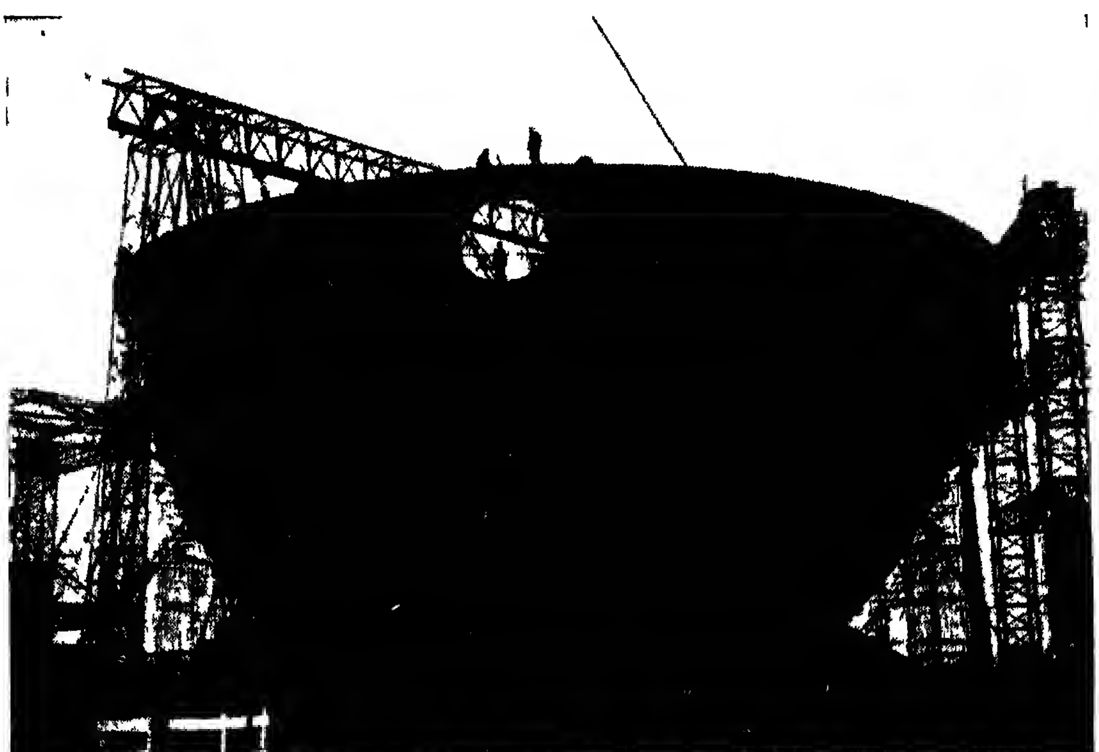


[By courtesy of Whessoe Ltd

FIGURE 22 *Calder Hall atomic power station—lowering the first section of the welded reactor vessel into position*

high. All the welds were completely X-rayed to Lloyd's Class I Standard, and once again stress relieving on site was used. It is interesting that every square foot of the plates used for the pressure shell of the reactor was examined with an ultrasonic flaw detector before fabrication. The design conditions were quite onerous. The vessel, in the first place, would contain carbon-dioxide at high pressure and high temperature. Secondly, the design of the vessel had to permit a considerable degree of expansion to allow for these temperatures and pressures. Thirdly, a moderator of graphite weighing considerably more than a thousand tons had to be supported inside the vessel. Fourthly, a multiplicity of holes had to be provided in the reactor shell. The vessel was constructed on site, and rings successively welded in position inside the concrete building. This involved the lifting of very considerable weights to a height of more than 120 feet in order to lower the successive pieces into the building (Figure 22).

The Breeder Reactor at Dounreay in Caithness also presents some unusual welding problems for, as a protective measure, the reactor is completely enclosed in a steel sphere, 135 feet in diameter (Figure 23). The sphere is made from shaped plates of steel specially treated to minimise the risk of brittle fracture. The plates are up to 12 feet 6 inches wide by 25 feet long. The preparation for welding was the normal double v butt with a root face. Low hydrogen electrodes were used throughout, all welded joints being examined by X-rays. The total weight of steel involved is about 1,500 tons, and there are about two miles of welded seam.



[By courtesy of the U K Atomic Energy Authority and The Motherwell Bridge and Engineering Co, Ltd.

FIGURE 23. *Dounreay atomic power station—the all-welded protective sphere in course of erection*

[By courtesy of Welding Engineer

FIGURE 24 *Protective sphere for housing experimental atomic submarine*

A similar sphere, no less than 225 feet in diameter, has been constructed in the United States for housing an experimental atomic submarine (Figure 24). This sphere is made from one-inch plates, and has no less than five miles of welding, all of which again has been inspected. This sphere, in addition, has a quarter of a million $2\frac{1}{2}$-inch long studs welded on the outside for the purpose of holding a layer of fibre glass thermal insulation to cover the entire 160,000 square feet or four acres of surface area. This sphere has a volume of nearly 6 million cubic feet.

LECTURE III

Monday, 30th April, 1956

RESISTANCE WELDING

Resistance welding is the process of joining metallic parts together by the heat generated mainly by the resistance created at their points of contact when a current is passed between them. British-born Professor Elihu Thomson is rightly regarded as the inventor and founder of the process which is so widely used to-day and without which modern mass production methods of construction would be almost impossible. There is some evidence that Professor Thomson was not quite the first to use resistance heating for welding. For example, in 1857 Joule called attention to the possibility of joining metals in this way though Lord Kelvin (then Professor William Thomson, but unrelated to Professor Elihu Thomson) first made the experiment. Joule reports having joined together in this way a bundle of iron wires and also to have joined steel to brass and platinum to iron.

Thomson's patents were taken out in 1886, though they were based on ideas which came to him in 1877. He was lecturing at the Franklin Institute in Philadelphia, using an induction coil in the reverse direction. The heavy currents, which passed through what is normally called the primary winding, caused a fusion together of the ends of the wire. This experiment remained dormant in Professor Thomson's mind for several years until the need for an effective method of joining together ends of copper wires presented itself. Apparently it was difficult to get wire of any considerable length in one piece, and welding together several joints in a coil was unavoidable. He designed a piece of equipment for doing this electrically and was immediately successful. It is interesting to note that between his first experiment and the filing of his patents, resistance welding appears to have been commenced at the cable making works of Siemens in this country. Here the steel armour wires were joined by a resistance-welded scarf joint which appears to have been entirely satisfactory, tests fracturing as often outside the weld as in the weld. It is curious that this practice appears not to have invalidated Thomson's patent.

The history of resistance welding in its early years is quite well documented. Several papers presented to the leading engineering societies in this country in the 1880s and the 1890s give a considerable amount of information. In one of these to the West of Scotland Iron and Steel Institute, the author, Mr. Duff, describes a butt welding machine which he saw in use at the works of Messrs. Clarke, Chapman & Co. This was in 1893, when the machine had been installed for several years. It was one of the earliest productions of the Thomson Electric Welding Company and is, in fact, still in use to-day—66 years after it was installed—doing the same job as that for which it was originally provided.

The development of resistance welding early in the present century was distinctly slow, and the retardation was undoubtedly due to the fact that in the early days no welding apparatus was disposed of outright. Each welding unit was built for a specific operation and was installed only on a royalty basis. On ordering the equipment, the purchaser had to deposit a certain sum for the

right to use the process and for the possession of the machine. If the machine was in satisfactory condition at the end of three or four months, the economy effected by the use of the method was calculated by comparison with the cost of ordinary joining methods. The purchaser then paid to the vendor a sum calculated on this basis—so much per completed weld, the number of welds made being registered on a counting device mounted on the machine. The sum paid amounted to 25 to 33 per cent of the economy effected. This arrangement continued for many years, and was considered fair and equitable to both parties, because the new method of welding was so far superior to the old methods of joining that it proved profitable to all concerned. As a result of this commercial arrangement, the business remained in the hands of one company until 1916 when, after many law suits, five others were licensed to produce welding machines.

The patents taken out originally by Thomson were drafted in wide terms, and although at the time he clearly envisaged only butt welding, it was finally decided by the United States Supreme Court in 1924 that they also covered spot welding. The commercial arrangements which were made by Thomson's company, and the excessive patent litigation on the subject of welding, undoubtedly slowed up its development both in America and in this country.

Butt welding, which was so popular in the early days, is now of only limited application. It depends on the continuous pressing together of two parts to be joined whilst a current is passing between them. Fusion eventually takes place at the contacting surfaces at which there is an increase of size due to the softening of the surrounding metal. The primary use of the process to-day is for joining wires in wire-drawing mills.

For the majority of joining applications, butt welding has been replaced by flash-butt welding, in which the parts are first brought together under light contact, when flashing and melting occur at the surfaces. The pressure is then increased and the two parts are forced rapidly together with the extrusion of oxide and metal which form a flash or fin which freezes around the joint. This is an effective cleansing process which means that the two parts which eventually come into contact consist of pure metal. Figure 25 shows typical flash-butt welding applications. These include fork

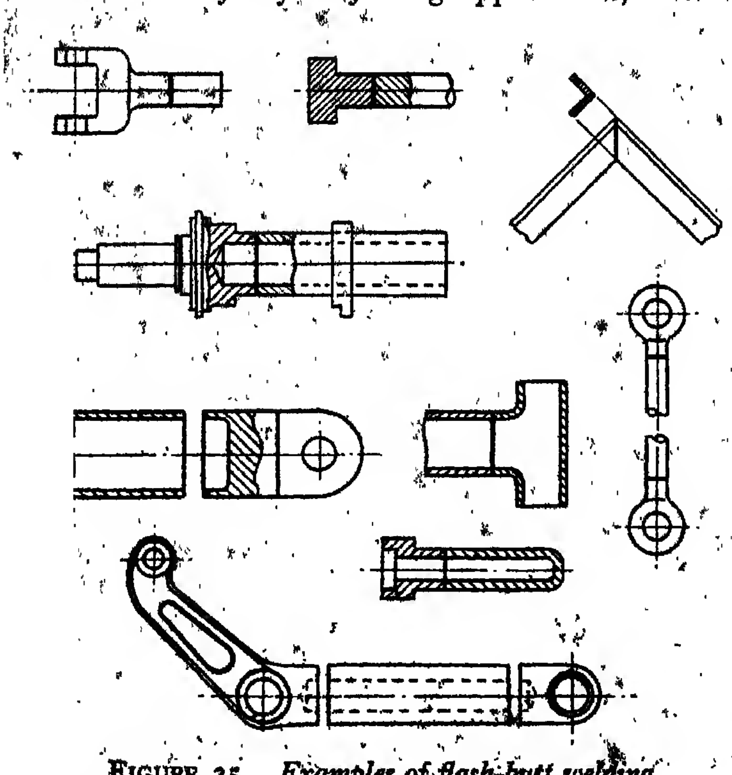


FIGURE 25. *Examples of flash-butt welding*

[By courtesy of A I Electric Welding Machines, Ltd

FIGURE 26. *Flash welding of three-link couplings—note the fin of metal formed*

ends for tie rods, tubes, mitre joints of window frames, and there are many other applications. It is usual to remove the flash by grinding subsequently to welding. Flash welding is frequently used for the construction of chains wherein the wire is formed into a loop and a single flash-butt weld completes the link. In the case of larger chains such as three-link couplings for railway coaches, the links are formed into two U-shapes and two flash welds are made at the same time. This is shown in Figure 26.

Spot Welding

Spot welding is the commonest form of resistance welding. It is most clearly described in the patent filed by Harmatta in 1903, and though this was finally declared invalid, it was evidently the introduction of the process. Harmatta says:

> The invention affords a cheap and practical substitute for riveting and is particularly useful in fastening plates and sheets of metal to one another. . . . In general terms the invention may be stated to consist in fastening the pieces together in an electric weld at one or more distinct or well-defined spots . . by the application of pressure and heating current.

A pair of copper or copper alloy electrodes, which are water cooled, are generally used. These apply the pressure to the work where welding is required, and serve to carry the current which is of the order of thousands of amperes flowing for a period up to several seconds. The resulting spot weld which is formed is shown in Figure 27. Conditions vary considerably, but the weld should occupy between twenty per cent and eighty per cent of the thickness of the two sheets—

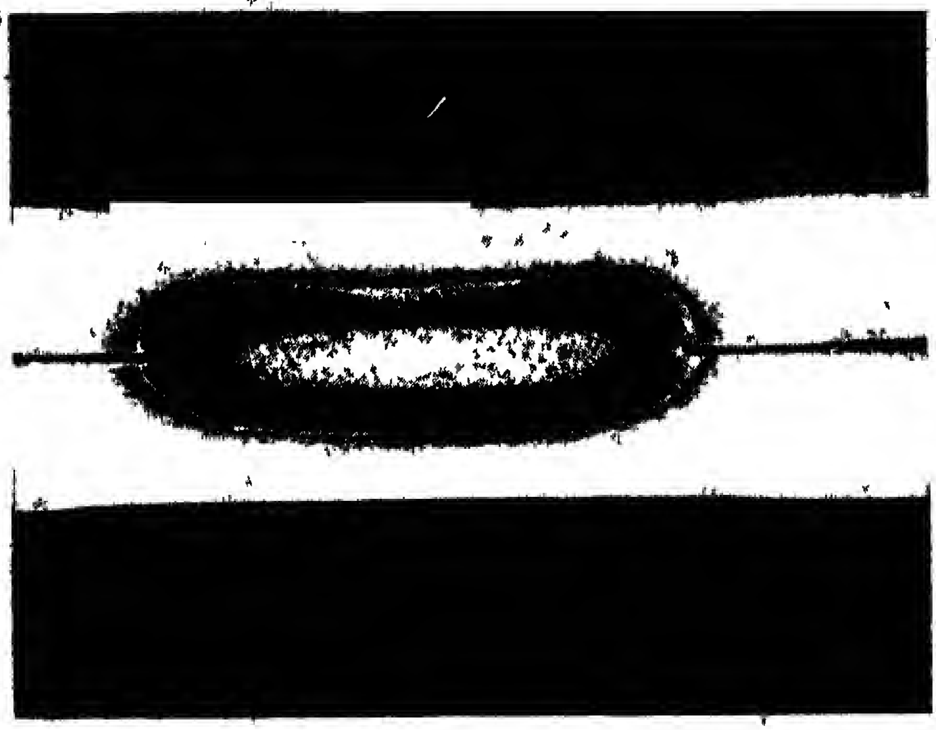


FIGURE 27 *A typical spot weld*

the thinner the sheets the smaller the figure—and should not contain cracks or blow-holes, neither should there be excessive indentation on the outside of the sheets. The method is particularly appropriate for mild steel, but also has wide application with stainless steel, alloy steel, and aluminium. In the early days, spot welding was done with small pedal-operated machines in which a mechanical contrivance arranged that the pressure was brought on before the current and was switched off before the electrodes were separated. The pedal-operated machine is now less common than it used to be, and all large machines are operated pneumatically. Moreover, there is much more complicated timing gear than used to be employed. This equipment ensures that the current flows for a very precise period of time which may be measured down to an accuracy of half a cycle. Resistance welding transformers generally operate from the normal power supply on the primary side, and have a single turn secondary. The secondary voltage is generally somewhere between two and ten volts, and the current may be many thousands of amperes. The impedance of the secondary circuit is made up of the resistance of the circuit, which is considerably influenced by the condition of the mechanical joints, and by the reactance which is determined by the configuration of the machine. Thus, spot welders which require a large gap between the arms, or which must have very long arms in order that the spot weld may be made in the middle of a sheet, have a high reactance, whereas projection welding machines which have short, stiff arms have a small reactance. Whilst the general procedure is to make one weld at a time with simple machines, series welding in which two welds are made together is not uncommon,

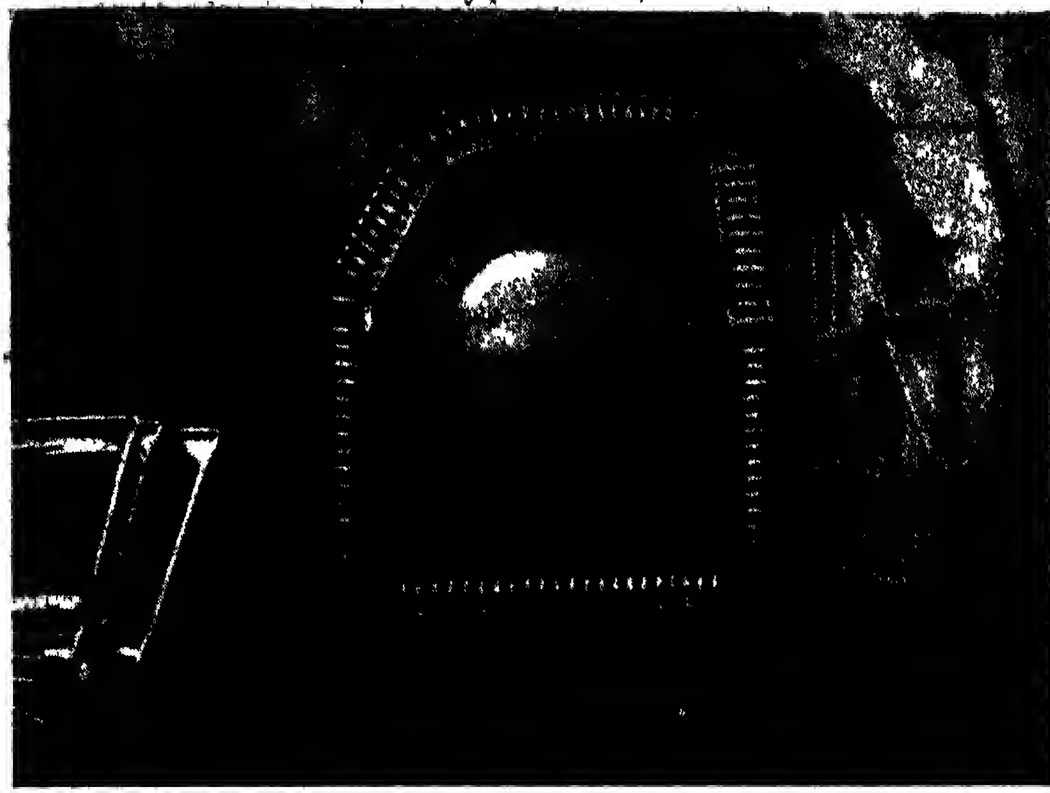


FIGURE 28. *Multi-electrode spot welding machine*

and in modern plant this process has been multiplied many times so that hundreds of spot welds can be made substantially together.

The development of spot welding is linked closely with the development of the motor car. It was first used for parts of cars in 1912, but within very few years became an absolute necessity, and the construction of modern cars would virtually be impossible without spot welding. Two methods are used—gun welders, that is portable spot welding machines, and secondly, the use of the press type welding machines in which large numbers of small spot welders operate at the same time. Such machines join together pressings for doors or chassis of motor cars. They are very elaborate and expensive machines, and can only be justified where a large number of similar products are made. In such machines, series welding is generally used, and the electrodes are hydraulically operated with spring return. Various arrangements are necessary to limit the power demand on the mains. This is done by ensuring that only a limited number of electrodes fire at the same time. Synchronization between the hydraulic and current control is necessary to ensure that the current is switched on after the electrodes come into contact, and off before they part. A multi-electrode spot welder for motor car doors is shown in Figure 28. This machine makes ninety welds in twenty seconds.

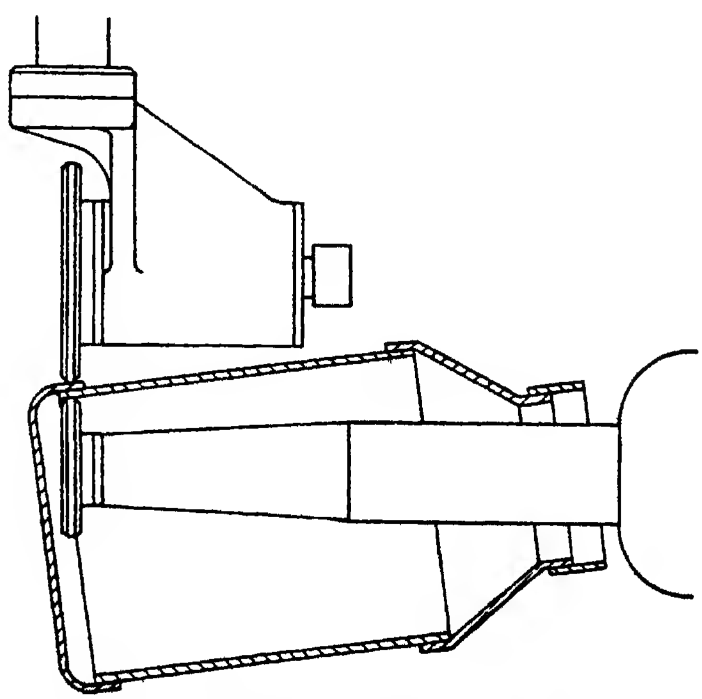
Projection Welding

A development of spot welding is known as projection welding. In this method,

instead of the location of current flow being determined by the position of the electrodes on the work, it is pre-determined by the position of dimples in one of the two sheets which are to be welded together. The sheets are then squeezed together with flat electrodes and a series of spot welds, corresponding to the number of dimples, is formed at the same time. The proper shaping of the dimples is a matter of some importance, and has been the subject of extensive research. The obvious advantage of this method is that a number of spots can be made at the same time, and their location precisely determined. Naturally much heavier pressures and higher currents are required for such machines than for machines making one spot at a time. There are variations of the process in which shaped projections, rather than dimples, are used when solid parts such as studs have to be attached to sheet. In such cases, an annular ring or ridge may be used as a contact point, instead of a conical pip. The development of suitably shaped heads for welding bolts to sheets was a subject of investigation by the British Welding Research Association and, as a result, it was possible to reduce the thickness of the head and its diameter and at the same time to determine the most satisfactory radius. This, it was finally decided, should be twice the diameter of the bolt, and the diameter of the head need be no more than $\frac{1}{8}$-inch greater than the diameter of the bolt.

Seam Welding

Seam welding is a popular and useful method of joining parts together. By this method, continuous pressure-tight joints can be made, and it has wide application in the light container industry. Both circumferential and longitudinal welds can be made with equal facility. The method uses generally two wheel



[By courtesy of Sciaky Electric Welding Machines Ltd

FIGURE 29. *Seam welding of a milk churn*

electrodes—one of which is driven. Pressure is applied to the joint through the wheel rims through which also the current passes. The flow of current is intermittent, being controlled generally to-day by an electronic timer, the duration of flow of current being controlled and also the interval between the times of current flow. In this way, virtually a series of spot welds is obtained which may be separated, or may overlap—an essential requirement where pressure tightness is necessary. Figure 29 shows diagrammatically the seam welding of a milk churn.

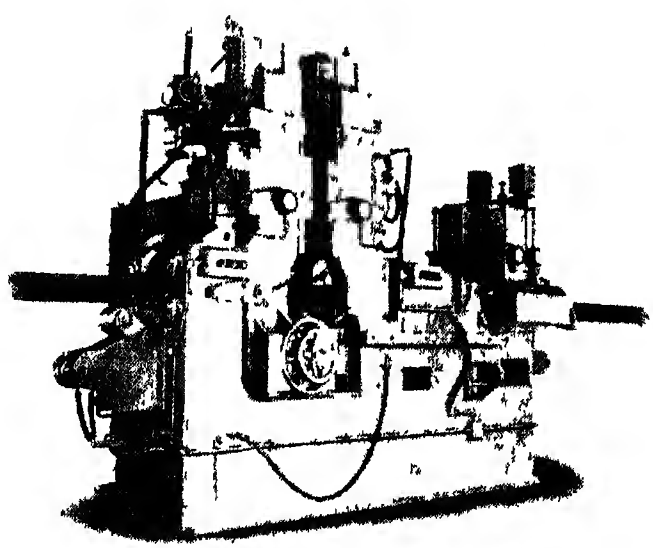
Seam welders are generally fixed machines, but occasionally portable machines have been made.

Special Machines and Applications

Flash-butt welding had a great vogue in the motor car industry for some years, being used to join together the edges of large pressed parts. This involved very large and heavy machines with elaborate clamping devices, but the process was eventually displaced because of the difficulty of concealing the joint.

The same method is used for joining together steel strip in the rolling mill process where joints up to perhaps six feet wide in quite thin sheet can be satisfactorily made so that the rolling is continuous.

Flash-butt welding of rails is also an important application of the process. This was first done in 1924, and after a slow start has now become a routine job which is fast approaching standard practice throughout the world. British Railways, who have been welding rails for some years, are constructing a number of rail welding depots, details of which have been given in the technical press. Figure 30 shows a rail welding machine. It is usual in this country to weld together lengths up to 300 feet, but there are at least two continuous lengths of rail of over a mile. Whilst flash welding is done in depots, site welding is done by the 'Thermit' process. There are in various parts of the world continuous lengths of rail of many miles, and there appears to be no difficulty arising from temperature changes. Welded rails show many advantages with substantial savings over the previous system of short lengths with fish-plated joints. There is reduced track maintenance with reduction of shock loading and consequent tyre wear on rolling stock. There is also increased comfort to the traveller. Special machines have been devised



[By courtesy of A. I. Electric Welding Machines Ltd.

FIGURE 30. *Flash-butt welding machine for rails*

for this process in which heat treatment of the weld takes place subsequently to the welding operation. Good alignment of the rails is, of course, necessary before the welding operation, and provision is made in the equipment for ensuring this. After the weld is made, the flash must be removed, and this is generally done whilst the rail is still hot, by a pneumatic chisel. A 110-lb. rail is welded in a time of about two minutes, with an energy consumption of about two units per weld. The normalizing of the rails subsequently to welding is done by heating to 850° C. for a distance of four inches on either side of the rail. This can be done by furnaces, but in some cases provision is made for doing it by means of resistance heating. The surface of the rail must be ground flush after the chipping operation, and the weld must be capable of standing a Tup test consisting of a one-ton weight dropped from a height of twenty feet, the rail being supported at 3 feet 6 inch centres. It is interesting to note that there is no difficulty in transporting, on a string of trucks, lengths of rail up to 300 feet; the rails bend quite satisfactorily around the curves.

Operation Pluto

Operation Pluto consisted in laying two types of pipeline under the English Channel, namely the HAIS cable, which consisted of an electric submarine cable, without cores and insulation, through which petrol could be pumped, and the HAMEL pipe line consisting of three-inch nominal bore steel tubes electrically flash-welded together into the full length required for laying, this length being coiled round floating drums from which it was unwound again on the bed of the Channel.

When proposals were made for the Hamel pipe early in 1942, it was to consist of a continuous steel tube three inches in diameter, wound on a forty-foot drum which could be towed across the channel, the pipe being unwound on the way. The tube would have to be eighty miles long and the longest solid drawn three-inch tube which could be made was forty feet. The only feasible method of joining forty-foot lengths of tubes of such a small diameter was by electric flash-butt welding. At the National Physical Laboratory it was established beyond doubt that a steel tube of required specification could be flash-butt welded and the weld subjected to bend, repeat bend, and tensile tests giving equivalent properties to that of the parent metal. In order to maintain the quality and consistency of the weld joint, only fully automatic machines could be employed and 16 flash-butt welding machines, each with a transformer capacity of 180 kVA and operated by oil pressure, were installed at the special site at Tilbury. The forty-foot lengths of tube were fed into the factory from a railway siding at the rear and by conveyors to each welding machine. By this means it was possible to have all 16 welding machines in operation simultaneously. Each weld in the three-inch diameter pipe took about 15 seconds and a welding production programme of 12 miles of pipes per day was maintained.

From the welding machine the sections of the pipe line, now each 4,000 feet long, were conveyed to the winding ramp where 400 miles of welded pipe could be stored; but before that could be done the external and internal flash created

by the forging action during welding had to be removed. Whilst the external extrusion presented little difficulty, the removal of the internal flash from the bore of the tube forty feet from the end was a more serious problem. It was, however, accomplished successfully by a cutting tool, incorporating a steel wire brush and reverse blowing nozzles inserted into the tube prior to welding. The driving spindle was 45 feet long, passing through the forty-foot length of tube being welded, and had a rotating action when drawn back for a distance of three feet, which was sufficient to clean the weld extrusion

The welded tubes were ultimately wound on a large steel drum resembling a huge cotton reel with conical ends, ninety feet long and fifty feet in diameter over the flanges. The part on which the winding was to take place was sixty feet long and forty feet in diameter, allowing a total radial thickness of some five feet of wound pipe. Fully wound, such a drum would hold about 19 layers of three-inch pipe, each layer consisting of about 180 turns, the actual total length being about 92 land miles or 3,416 turns (Figure 31) Various trial lays were carried out with these drums and they were found to operate quite successfully even in rough seas, although very powerful tugs were required to tow them.

A total of 970 miles of pipe was made, incorporating some 198,000 flash-butt welds and the weight of pipe welded within the period was 17,120 tons. Pumping stations on the English shore from which the pipeline ran into the sea had also

By courtesy of the Ministry of Supply Armament Research and Development Establishment

FIGURE 31 *Flash-butt welded pipeline 'Pluto' being coiled on to laying drum*

to be prepared. These stations were at Ventnor and Dungeness. Their preparation involved a great deal of secret work and careful camouflage, the pumps being installed in bungalows, ice-cream parlours, fair grounds, and so forth. This part of the operation was carried out so well that no hint of the position of these pumping stations appears to have been given to the enemy. Lines were first laid from Ventnor to Cherbourg but, as it became possible much earlier than was expected to operate the scheme further east, the main lines (six Hamels) were laid between Dungeness and Boulogne.

No exact data are available as to the delivery quantities from the various lines but it is known that the quantity delivered to Cherbourg was about forty g.p.m. per line with a pressure of abut 1,250 lbs/sq. in. and about eighty g.p.m. at the same pressure for the shorter lines to Boulogne. Altogether, when the scheme was working fully, about one million gallons of petrol a day were pumped across the Channel.

Aircraft

There is considerable divergence of opinion about the best method of making joints in aircraft. The first and still the commonest method is by means of the hollow rivet. The latest method is by the use of adhesives. For many years, spot welding has been employed, and much research has been done on the proper preparation of the aluminium alloy sheets. Very great use is made of spot welding in a limited range of British aircraft, but apparently a considerably wider use in the United States. The advantages of welding as compared with riveting are that it is cheaper, it reduces the drag, it reduces the weight of the aircraft and it reduces sealing problems. The reduced drag arises from the retention of a better contour of wing sections, and there is better joint matching with welding than with riveting. It is perhaps seldom realized how many rivets or welds are required in an airplane, but the figure is not uncommonly measured in millions. One million $\frac{3}{16}$-inch diameter aluminium rivets weigh 173 lbs.—which is quite a significant addition to the weight of an aircraft. Welding, moreover, permits reduced overlap on joints, and a case has been cited with a transport aircraft where 460 lbs. of weight were saved due to a reduction in the amount of sealing compound used.

In the case of one American aircraft, it was proposed to use integrally stiffened wings made by hot pressing. Unfortunately, the necessary presses were not available at the time, and it was essential to change over to spot welding. This was done without modifying the gauge of the material and without increasing the weight of the aircraft. One thousand of these aeroplanes have been made, and it is reported that there is no single case of trouble with the spot welding. Other examples of welding on aircraft are the use of spot and seam welding for outside fuel tanks, and flash-butt welding of under-carriage parts which are generally made from tubular alloy steel.

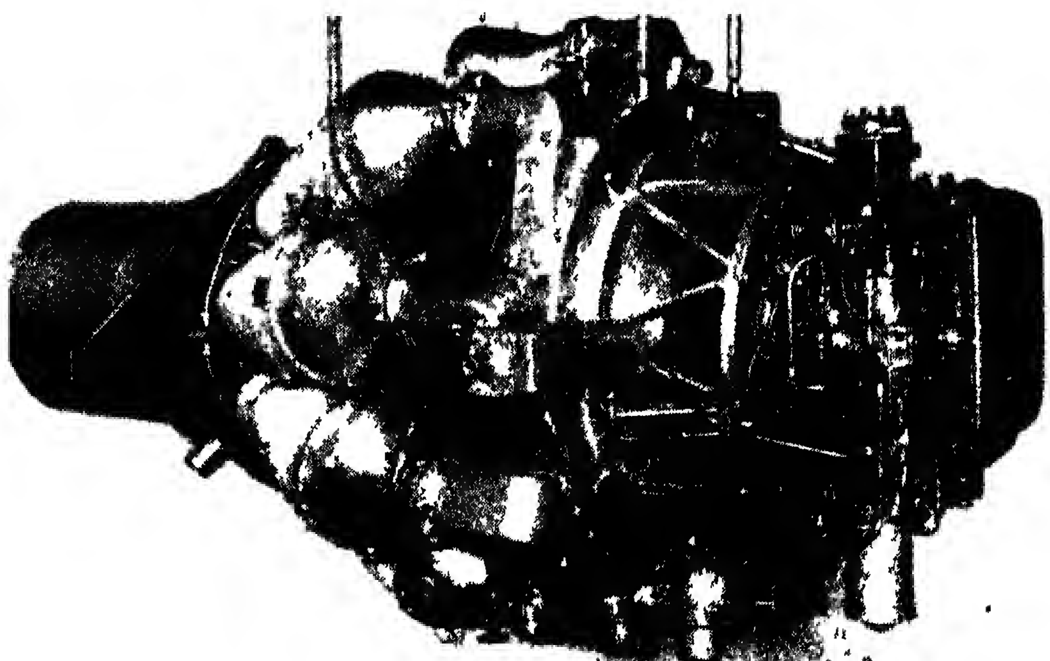
An important application of spot welding to aircraft is the Handley-Page 'Herald', a recently introduced aeroplane designed for operation on short-to-medium range branch lines and able to carry 44 passengers or freight. This

aeroplane contains over 100,000 spot welds, many of which are in the primary structure which is something of an innovation for British aircraft.

Jet Engines

The use of resistance welding in the construction of modern jet engines is an important modern development which is vital to the efficient production of this type of machine. Flame tubes, exhaust units and jet pipes make use of a number of different types of heat resisting alloys, each of which presents its own welding problems. The situation, moreover, is sometimes complicated by the need to join different types of materials or different thicknesses of materials together. An essential requirement in this field is an exceptional degree of accuracy with very thin sheet material. This has led to high precision work of a quality which is unexcelled in any other branch of industry.

In the resistance welding processes, spot, roll spot, and seam welding are the principal methods used, though there is some application of flash-butt welding. In the case of the Derwent engine, which is illustrated in Figure 32, the exhaust unit consisting of an outer truncated cone, made from stainless steel sheet, is machine welded to flanges on each end, and this cone is joined to an inner cone by cross-tubes made from Nimonic 75 spot welded to austenitic steel. Jet pipes are commonly made from a number of cylinders which are wrapped and seam welded longitudinally and joined together with circumferential seam welding. The flanges which are roller spot welded to the jet pipe, are made by flash welding the two ends of a flat hoop together before forming the shape by rolling.



By courtesy of Joseph Lucas (Gas Turbine Equipment) Ltd

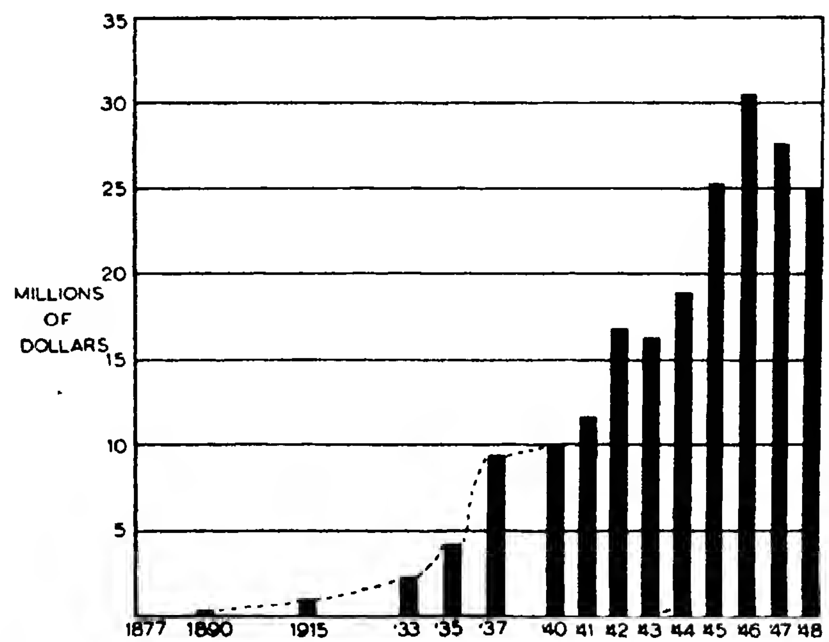
FIGURE 32. *Rolls Royce 'Derwent V' jet engine*

Economics of Resistance Welding

Cost comparisons for resistance welding *versus* arc welding, or for welding against other methods of construction, are not often available, but Stanley in his book on resistance welding says that careful comparisons were made during the war between the cost of spot welding and riveting light alloys in the aircraft industry. He states that skin panels measuring 24 inches by 60 inches were stiffened by five stringers. He quotes flush riveting for this job as taking nearly three times as long as spot welding. Similar more recent information has been given relating to the Matador guided missile. This was automatically riveted for four months, and the method was then changed to spot welding. For riveting, 7·9 man-hours were required for assembly, whereas for spot welding the figure was only 1·7. Stanley compares the cost of arc welding armour plate with resistance welding using automatic spot welding machines. He deduces that 38 machines manned by semi-skilled men could do the same job as 200 highly skilled arc welders. The saving was estimated to be such that even if the spot welding machines cost as much as 50,000 dollars each their cost would have been saved in the first year.

Growth of the Industry

A chart (Figure 33) based on American statistics shows how the resistance welding industry—as expressed in terms of sales of resistance welding machines



[By courtesy of W. A. Stanley and McGraw Hill & Co

FIGURE 33. *The growth of the resistance welding industry in the United States*

has grown since it was first introduced. Recent figures have probably exceeded the wartime peak. There is no reason to think that similar developments have not taken place in this country.

CONCLUSION

And so we come to the end of the welding story. I have shown the brighter side of the picture, but the very fact that there exists a research association devoted to welding is evidence enough that we are far from solving the last welding problem. In the first lecture, an account was given of the tools of the trade and the methods of using them—the good old standby, the hand-operated metal arc electrode, which for all its defects probably still accounts for ninety per cent of the electric welding which is done; its big brother the automatic metal arc electrode in two forms, the coiled coated wire, and the bare wire using a powder flux; the tungsten arc with shielding gas, so suitable for light alloys and special steels; and finally, the gas shielded metal arc—that modern high speed process which lays metal down so quickly that its economic advantages can be lost if there is not equal acceleration in the ancillary processes.

The second lecture describes the applications of welding—applications which cover all phases of engineering and much of our every-day life. From bicycles to boilers, from horse-shoes to highway bridges, from tool tips to tankers, not forgetting heat exchangers, motor cars, giant excavators, dock gates, rockets, steel frame buildings, aircraft, and nuclear power plant—in all these welding plays a large and vital part.

Research is necessary to ensure that the best use is made of existing methods, to find the limitations and applications of other methods and to solve some of the elusive problems which inevitably arise when an attempt is made to join cold wrought metal by hot cast metal.

In the broad field of increased productivity, welding is playing a great part. There is considerable scope, however, for improving productivity *in* welding, that is in reducing the man-hours per ton of welded steelwork, and some research effort is being devoted to this important field too—not so much towards choosing the best method, but rather towards ensuring, with any method, that the greatest possible output per man for the required quality is obtained—bearing in mind that the welder himself is only one of quite a number of men who contribute to this figure.

There is no limit to technical developments, and we should do well to adopt the motto that 'there must be a better way'—if only we can find it, but it may well be that the greatest advance in the next few years will be made by improving the application of the tools which we already have at our disposal.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge help received in the preparation of these lectures from Mr W. Andrews; Mr R. G. Burt; Mr. H. E. Dixon; Dr N. Gross, Mr P. T. Houldcroft, and Mr P. T. J. Leder.

Slides and illustrations have also been kindly lent by the following:

Admiralty, Engineer-in-Chief's Department, A. I. Electric Welding Machines Ltd., W. S. Atkins and Partners; Babcock and Wilcox Ltd.; The British Aluminium Co., Ltd.; The British Oxygen Co., Ltd., Professor W. Fisher Cassie, Costain-John Brown Ltd.; The English Electric Co., Ltd., Guest, Keen and Nettlefolds Ltd., G. A. Harvey Company (London) Ltd., Havelock Engineering Company Ltd. Her Majesty's Stationery Office, Joseph Lucas (Gas Turbine Equipment) Ltd., Midvale-Heppenstall Co., Philadelphia. Ministry of Supply Armament Research and Development Establishment; The United Kingdom Atomic Energy Authority and The Motherwell Bridge and Engineering Co., Ltd., Murex Welding Processes Ltd., Orenstein Koppel und Lübecker Maschinenbau; Philips Electrical Ltd.; Quasi-Arc Ltd.; Sciaky Electric Welding Machines Ltd.; *Scope* and Morfax Ltd., Shell Photographic Unit; Siemens, Schuckertwerke Aktiengesellschaft, Berlin, South Durham Steel & Iron Co., Ltd.; W. A. Stanley & McGraw Hill & Co.; Stewarts and Lloyds Ltd.; John Summers & Sons Ltd.; Thompson Brothers (Bilston) Ltd.; Tubewrights Ltd., Vickers-Armstrongs (Shipbuilders) Ltd., *Welding & Metal Fabrication*; *Welding Engineer* Chicago; Whessoe Limited.

GENERAL NOTES

COVENTRY CATHEDRAL WINDOWS EXHIBITION

An exhibition that is worth seeing at the moment is that of the stained glass for the new Coventry Cathedral, now on show at the Victoria and Albert Museum, where it will remain until 30th September. It forms part of the large commission given to the Royal College of Art who selected Mr. Lawrence Lee, Mr. Keith New and Mr. Geoffrey Clark to design and carry out the work.

Six of the ten nave windows which will eventually be erected in the Cathedral are on view. Such an enormous display of glass—each window is seventy feet high—is a little overwhelming, but this is because the floor space available does not afford sufficient room to arrange the windows farther apart, as they would be in the Cathedral.

Each window conforms to a colour scheme set by the Architect, Mr. Basil Spence, A.R.A., and, to quote Mr. Lawrence Lee, the windows 'are semi-abstract in design with themes broadly based on the progress of Christian man through this life to the world to come'. This method of design is well suited to the architecture where the windows are so arranged that they face diagonally towards the altar, which is the one place from where they may all be seen as a complete scheme. The altar is not in the customary position, in the east, but in the north, so that all the nave windows will receive strong southern light.

This good light enables the designers to employ an orthodox technique of painting, using varying textures of patterns and half tones to control their medium. Taking into account the sweeping lines of composition running through the mullions and transom bars, the arrangement of colour and the way that paint has been used, parts are curiously reminiscent in effect of the later periods of mediæval stained glass. At the moment the glass is lit by artificial light, which cannot convey the brilliance it will have when set in the fabric of the Cathedral. Some of the colour passages are distorted, for instance in some cases whites appear yellow, and purples, in the red window, do not show to advantage.

An unusual feature of these windows is that they are only two feet from the floor, whereas in most of the cathedrals the glass is usually well up above eye level and set against the sky. It is certain that some of the richness of colour must be lost in the bases of the windows when viewed against the ground.

What must be one of the most difficult parts of this commission is to maintain a balance with the tone values of the colour schemes in each window, particularly when three designers are employed, each with their own respective windows. The danger is that if some of the windows are too light they could make the others appear too heavy and *vice versa*. However, there is enough glass displayed to enable one to see that a happy relationship has been preserved between one window and another, and the artists are to be congratulated on what must be an outstanding achievement in the medium of stained glass.

CARL EDWARDS

MEDIÆVAL PAINTINGS EXHIBITION

An exhibition of fourteenth- and fifteenth-century paintings, eight panels from the church of St. Michael at Plea in Norwich, is also at present on view at the Victoria and Albert Museum, where it will remain until 28th October. The paintings were brought to London for restoration, and this work was carried out on the principle that original paint should not be retouched, but that missing areas should be replaced in those cases where the original appearance could reasonably be deduced.

The exhibition is supplemented by photographs of the panels before and after restoration, and of a selection of comparative material. It is open from 10 a.m. to 6 p.m. on weekdays and from 2.30 to 6 p.m. on Sundays. Admission is free.

BRITISH ASSOCIATION MEETING

The 118th Annual Meeting of the British Association for the Advancement of Science will be held in Sheffield from 29th August to 5th September, 1956, under the presidency of Sir Raymond Priestley, M.C. The meeting's scientific programme will this year be particularly concerned with industry, while present explorations in Antarctica, and the forthcoming International Geophysical year are also among the subjects to be discussed. There will, in addition to the lectures and discussions given in each section of the meeting, be the usual showings of scientific films, social functions, and excursions.

Membership of the British Association is open to all, no scientific qualifications being necessary. The membership fee is two guineas for adults and 10*s*. for students and school-children. Details of this, and of the meeting, can be obtained from the Secretary, British Association, Burlington House, Piccadilly, London, W.1.

OBITUARY

MR. W. H. GALLIENNE

We record with regret the death, at his home in Guernsey on 17th July, of Mr. W. H. Gallienne, British Ambassador to Cuba.

Wilfred Hansford Gallienne, C.B.E., was born in Guernsey in 1897. He served in France during the first years of the 1914-18 war, but after a serious wound was seconded in 1917 to the War Office. In 1919 he entered the Consular Service, being appointed Vice-Consul at Marseilles. He later served in Algiers and Chicago, and after a period in Central America, where in 1930, as Chargé d'Affaires and Consul at Santa Dominco he was special Envoy for the inauguration of the President, was sent to Tallinn, Esthonia, as Chargé d'Affaires and Consul. He remained in that post until 1940, being appointed Minister shortly before he left Tallinn in the same year. In 1942 he was appointed Consul-General in Chicago, and in 1947 became Minister to Guetemala. In 1954 he was promoted Ambassador, and transferred to Cuba. He was appointed C.B.E. in 1931.

Mr. Gallienne was elected a Fellow of the Society in 1949.

SHORT NOTES ON BOOKS

THE EARTH IS MY CANVAS. *By Percy V. Cane, Methuen*, 1956. 42*s*

Gardens which have been designed by the author, who is well known as a garden architect, are here described. Each individual site presents a challenge to the designer, and Mr. Cane gives in each case a full account of the problem, and how it was solved. There are many half-tone plates, and some line illustrations.

THE BRITISH JOURNAL PHOTOGRAPHIC ALMANAC. *H. Greenwood & Co., Ltd.*, 1956. 8*s* 6*d*

Articles on various aspects of photography are combined with general sections on such subjects as chemicals, flash photography, three-colour photography, and a review of photographic apparatus and materials in the current volume of this Almanac, now in its 97th year.

ENJOYING MODERN ART. *By Sarah Newmeyer. New York, Reinhold*, 1955. 40*s*

Beginning with neo-classicism the author, who for 15 years was publicity director of the Museum of Modern Art, New York, traces for the lay reader the development of art in the nineteenth and twentieth centuries. Her theme is the evolution of art

as communication, and many illustrations are provided, mainly of paintings now in American collections.

RENOLD CHAINS. *By Basil H. Tripp Allan & Unwin*, 1956. 21s

In tracing the history of one company from 1879 to 1955, the rise of the precision chain industry is described. To-day the precision chain is an essential method of transmitting driving power in machinery; this little-known piece of engineering development is in this account linked with the technical, business and human problems facing industry as a whole.

SIMPLE PERSPECTIVE. *By Arthur R. Brown. Crosby Lockwood*, 1956. 6s

Perspective drawing of a plan gives a greater sense of how the finished produce is intended to look than can be conveyed to the layman by either the various systems of metric projections, or by orthographic projection. In this book the method is described with line diagrams.

MODERN OFFICE BUILDINGS. *By Michael Rosenauer. Batsford*, 1955. 35s

The practical aspects of office building are here discussed by the architect of the Time and Life Building in Bond Street, London. Examples of work in nine countries are given with over 100 illustrations, the author having worked in Vienna and London before going to America.

FROM THE JOURNAL OF 1856

VOLUME IV. *8th August*, 1856

HOLIDAY TRAVEL

From a report on Public Health

The following is extracted from the Registrar-General's last Quarterly Report.

'At this season of the year, when many people are travelling on the continent, as well as in England, it may be useful to state that it is now well established, by extensive observation, that England is the healthiest country in Europe. France stands next to England in salubrity. In the continental cities the annual rate of mortality is seldom less than 30 in 1,000; and the rate frequently rises to 40 in 1,000. In London, the rate of mortality is 25 in 1,000.

'On an average of ten years (1841-50) the mortality was at the annual rate per 1,000 of 15 in three English districts, 16 in 14 districts, 17 in 47 districts, 18 in 87 districts These facts prove that the climate of England is eminently salubrious; and it has not yet been shown that the climate of any part of the continent is equally or more salubrious than this island, crowned with hills of moderate elevation, sloping towards the east and the south; bathed by the showers of the Atlantic, drained naturally by rivers running short courses to the sea, cultivated more extensively than other lands, and producing those unequalled breeds of sheep, cattle, and horses, which flourish only in healthy places.

' . . . and it should be always borne in mind in selecting places of resort that through the peculiar nature of zymotic diseases, places usually healthy are periodically visited by epidemics, which can only be avoided by consulting recent returns, or by actual inquiries on the spot. The cleansing and the sewerage of all water-places require improvement, as their arrangements were made when sanitary science was at a low ebb'.

ERRATUM

It is regretted that the name of Sir Cyril Hinshelwood, M.A., D.Sc., P.R.S., Dr. Lee's Professor of Chemistry, University of Oxford, was incorrectly given on page 671 of the last issue of the *Journal* as Sir Charles Hinshelwood.

LIBRARY ADDITIONS

PAINTING, DRAWING, SCULPTURE AND ENGRAVING

GROZINER, WOLFGANG—Scribbling, drawing, painting: the early forms of the child's pictorial creativeness: translated [from the German] by Ernst Kaiser and Eithne Wilkins. *London, Faber*, 1955.

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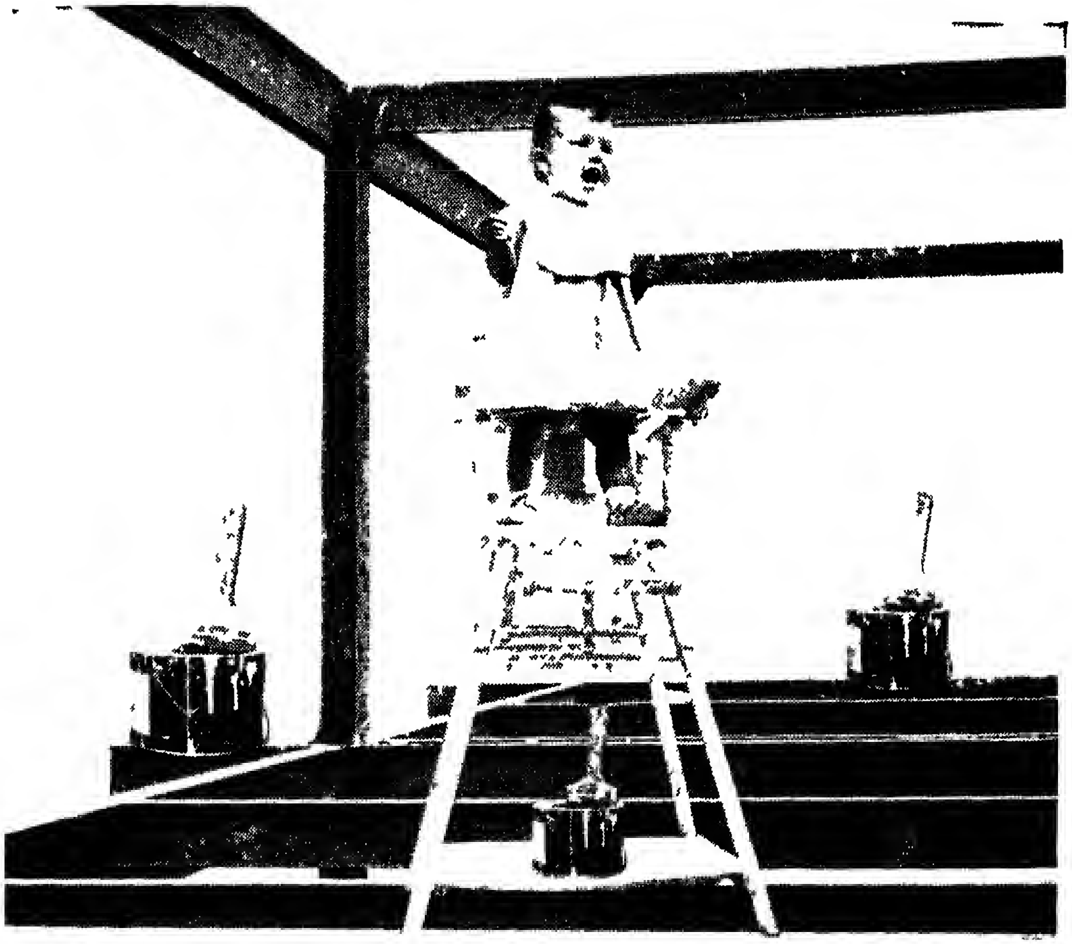

R.S.A. PUBLICATIONS

The following are some papers and lectures read to the Societ[y] in recent years. Copies of the *Journals* in which they we[re] published are obtainable on application to the Secretar[y]. Fellows are allowed a discount of 25 per cent Lists of tit[les] of papers and lectures read in earlier years are also obtainabl[e] on application.

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VIRUS DISEASES OF PLANTS F. C. Bawden .. 2

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The Society's *Journal*, which contains full reports of the Society's meetings, together with general articles, book reviews, etc., is published fortnightly and is posted free to Fellows. Correspondence concerning *Journal* advertisements should be sent to the Advertisement Agent, Journal of the Royal Society of Arts, at the Society's House.

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NO. 4984 FRIDAY, 17TH AUGUST, 1956 VOL. CIV

CONFERENCE ON TOWN AND COUNTRY AMENITIES

The Council of the Society has decided on the advice of a small Committee which has been set up under the chairmanship of Sir Stephen Tallents, to hold a Conference in the autumn with the object of increasing public concern about the dangers threatening the appearance of the towns and countryside in England and Wales, and of suggesting ways of meeting them. The Conference will be in a sense a sequel to the two lectures on 'Beauty in Danger' given in the last Session. The Minister of Housing and Local Government, who commended the Society's action in arranging those lectures, has agreed to open the Conference which will take place on Wednesday, 31st October, 1956.

Full details of the Conference programme, and of arrangements being made in connection with invitations to it, will be announced later in the *Journal*. It is hoped that as many as possible of the large number of organizations who are concerned with the problems to be discussed will be represented, and a limited number of places will also be reserved for Fellows of the Society. No applications for invitations should be made at this stage.

THE SOCIETY'S CHRISTMAS CARD

This year's Christmas card, the subject of which, as has already been announced, is Benjamin Franklin attending a committee meeting of the Society in 1759, is now in an advanced stage of production, and, it is hoped, should be ready for despatch by the end of September at the latest, thus allowing good time for posting to all parts of the world.

A few specimen cards will be available shortly, and the Secretary will be glad to send one to any Fellow who would like to see it.

An order form for the cards is included at the back of this issue of the *Journal*.

A NEW CONCEPT IN THEATRE DESIGN

A paper by

NORMAN R. BRANSON, A.R.I.B.A.,

read to the Society on Wednesday, 29th February, 1956, with Sir Kenneth Barnes, lately Principal of the Royal Academy of Dramatic Art, in the Chair

MR. WILLIAM JOHNSTONE, O.B.E., D.A. (A Member of Council of the Society): This afternoon Mr. Tyrone Guthrie, who was to have taken the chair, is ill with influenza and is therefore unable to be here. Sir Kenneth Barnes has kindly come to deputize for him, and I take this opportunity of thanking Sir Kenneth for stepping into the breach.

THE CHAIRMAN: I am sorry you have not got the excitement of having Mr. Tyrone Guthrie in this chair, because he is always exciting. I am afraid that is a quality that with increasing years has diminished in my personality! However, I am very glad to be here as a figurehead to deputize for him; and I may say that I am extremely interested in the subject. In fact, I was coming to listen to this paper. The Society noted that, and telephoned to me at the last moment to ask if I would take the chair instead of being a member of the audience.

The interest in the substance of the paper is, I feel sure, widely felt by all of those present who have come here to hear Mr. Branson; and I do not wish to take any time now in formally introducing him. His introduction will consist in what he is going to tell us of his present work, which seems to be on the verge of being accomplished. He is working for a very enterprising company run by Mr. Emmet, who is here to-day. I know that we shall all be anxious to find out what the Questors have in mind, which is what Mr. Branson is going to explain in his paper on 'A New Concept in Theatre Design'.

The following paper, which was illustrated with lantern slides, was then read:

THE PAPER

The Questors Theatre Ltd., for whom the designs of the new Playhouse have been prepared, is a non-profit distributing company limited by guarantee and with a membership of 1,500. It is recognized by the Inland Revenue as an educational charity and is the successor of the unincorporated association known as the Questors which was founded in 1929. Since 1933 the Questors has been operated as a private theatre club and is the owner of the freehold site upon which the new theatre will be built.

The architect's approach to his work must include research into the historical development of his subject. When designing a new theatre building he must be aware of the history of the playhouse and particularly of its more recent history. It is a striking fact that, whereas the whole long history of the playhouse has been one of gradually changing form, this process of change seems to have been arrested some eighty or a hundred years ago, since when there has been virtually

no significant change in its architectural form. This, despite the fact that in all other fields of human activity and thought the period in question has seen the swiftest and most radical changes to have occurred in the whole history of man.

It is no part of my purpose to-day to investigate the reasons for this arrestment of progress—whether and how far it may be due to the restrictions of the theatre licensing regulations, which require the construction of a proscenium wall and the provision of a safety curtain and thus do not allow of any theatrical form other than that of Victorian times when the regulations were brought into being, or whether it is because so few theatre buildings in this country have been associated with a developing artistic policy, or whether the picture frame or peephole theatre, with which we are all familiar, has reached a point beyond which it can develop no further. These matters are for the theatre historian to determine. The awareness of these possibilities may, however, affect the architect's approach to the problem of deciding what form a new theatre should take.

It must be remembered that there has been virtually no new theatre building at all in this country for some 18 or maybe twenty years, so that in any event there has been a clear break in the tradition of theatre planning as long as that of the Commonwealth. These are but some of the historical considerations which seem to support the need for a fresh approach to the question of what a playhouse should be.

Basically, however, the need to find a theatrical form more satisfying than the picture-frame arrangement sprang, as far as the Questors were concerned, from their own practical artistic experience over the past 25 years. Their early productions were upon a somewhat shallow stage behind a conventional proscenium arch. Then a forestage in front of the picture frame began to be added for some classical plays such as those of Shakespeare and Sheridan. Later this was extended to certain modern plays written in a non-naturalistic vein such as Obey's *Noah* and Denis Johnston's *A bride for the Unicorn.* This was done largely for utilitarian reasons to gain more space and to facilitate the flow of the play by giving, in effect, two playing areas—the mainstage and the forestage—between which the action could alternate as desired. It was found in practice that the use of the forestage resulted in a very pleasing and easy relationship between the actor and the audience.

It then came about that the forestage began to be used also for plays written in a purely naturalistic convention, starting with Ibsen's *A doll's house.* That was ten years ago and since then the Questors have experimented with the use of a forestage in many different ways for all types of play, the forestage tending more and more to become not the alternative playing area as at first conceived but rather an extension forward of the main stage area. This unifying of the playing areas has ensured that the action of a play flows naturally and smoothly out towards the audience. New techniques of presentation had to be devised, first to discover and then to utilize the full possibilities of this arrangement. On occasion, and within the limitations of their present building, experiments have also been made with a stage extended further into the auditorium, thus giving an open stage arrangement with the audience on three sides of the actor.

It is perhaps also interesting to mention that as far back as 1935 the Questors carried out a somewhat abortive experiment in 'Arena Theatre' in which the audience entirely surrounded the action. All this experiment was not, of course, in isolation nor was there anything particularly new or unique about it.

The movement away from the picture-frame stage was probably started in this country by Terence Gray's Festival Theatre at Cambridge which opened in 1926. John English's 'Arena Theatre' has since 1948 been touring the country playing on an open stage in a large marquee. The Edinburgh Festival has been notable for its open stage performances in the Assembly Hall since Tyrone Guthrie's first production of *The satire of the three estates* in 1948. Jack Mitchley for some years specialized in true arena productions and both professional and amateur groups have been experimenting with the same style of presentation. The deep forestage of the re-modelled Old Vic Theatre was a less bold step in the same direction, restricted perhaps by the architectural limitations of the old building. The currently popular ice shows use an arrangement of stage and scenery fundamentally the same as that of an open stage. A similar tendency is found in many countries abroad, notably in the United States, where there are a number of well-established theatres 'in the round'. In Paris a professional arena theatre was opened a little over a year ago.

One thing is clear from all this background—that there is a considerable movement in the theatre to break away from the picture-frame stage. The general direction of that movement also seems clear—towards a closer and more intimate relationship between the actor and the audience and towards a theatrical illusion which, with their collaboration, is created in the imagination of the audience. This form of illusion is quite distinct from that created in full naturalistic detail on the stage with a minimum of contributory effort by the observers. To sense that, however, is still a long way from finding the answer to the question 'What kind of playhouse, what shape, what physical arrangement?' The Questors, therefore, set out consciously—even, perhaps, a little self-consciously—to re-study the basic principles which should govern contemporary theatre requirements. In this and in all stages of their thinking and planning they were assisted by a panel of eminent people of the theatre, among whom were Miss Muriel St. Clare Byrne, Mr. John Allen, Mr. Frederick P. Bentham, Mr. E. Martin Browne, Mr. George Devine, Mr. Tyrone Guthrie, Mr. Michael MacOwan, Mr. Norman Marshall, Mr. Bernard Miles, Mr. Osborne Robinson, M. Michel Saint-Denis, Mr. Glen Byam Shaw, Mr. Richard Southern, Mr. Andre Van Gyseghem, and Mr. Michael Warre.

Initially their thought was directed towards the kind of actor-audience relationship which would best aid the imaginative illusion to which I have referred, as distinct from the naturalistic illusion. This led directly away from the picture frame or other arbitrary barrier between the player and the audience. Further, it seems to require conditions which will help a ready sharing of experience between the actor and the audience: indeed, the sharing of experience may be the fundamental principle which makes the theatre work. At this point we become concerned not only with the relationship between actor and individual

member of the audience but also with that between the actor and the body of the audience and between the individuals who make up the audience. That 'intimacy' is not merely the same as 'closeness' can be readily appreciated by considering a performance given to a small audience in a large theatre. Even if the audience be concentrated in the front two or three rows of the stalls, so that the distance between the actor and the furthest member of the audience is only a few feet, there would be little sense of intimacy. This sense depends upon the psychological relationship between the members of the audience and this is governed in part by their physical grouping.

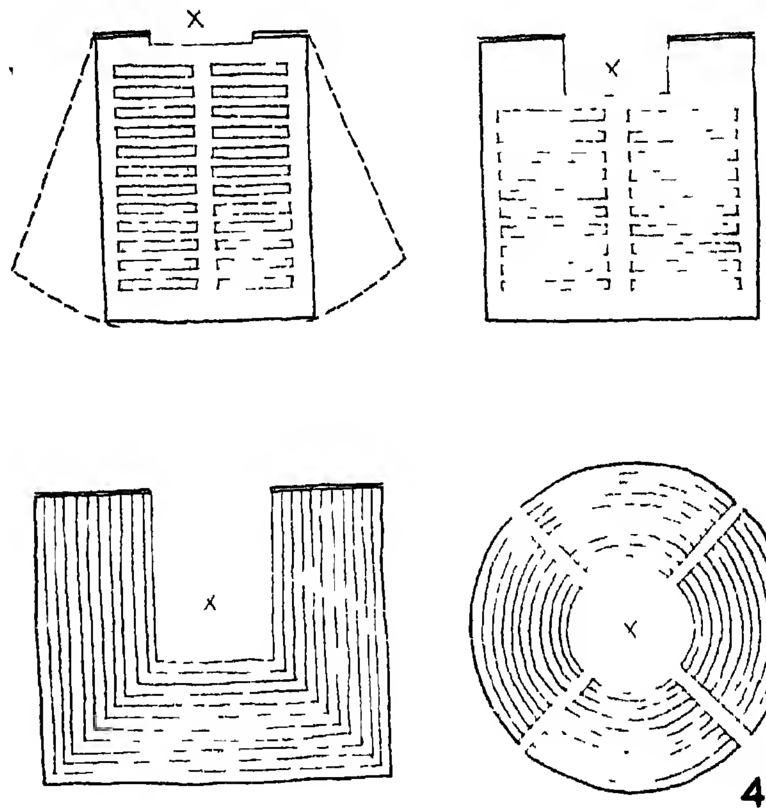

FIGURE 1. *Actor-audience relationship*

Four problems, therefore, present themselves for consideration at the commencement:

(*a*) The optimum distance between the actor and the audience.
(*b*) The size of the auditorium.
(*c*) The grouping of the audience in relation to the actor.
(*d*) The grouping of the audience in relation to itself.

Having isolated the problems, the next step is to consider what shape of auditorium and what stage plan would best combine to promote the desired quality.

The first diagram in Figure 1 shows the actor confronting his audience from a stage enclosed by a proscenium wall and the audience in seats parallel with

the stage. This is the conventional village hall plan. If it be extended at the sides, so that a fan shape is formed, this will give a typical cinema plan. If boxes be added together with a circle and gallery we have a simplified version of the conventional proscenium picture-frame theatre. The nearest point which the actor can approach the audience is that established by the proscenium arch and the play must be viewed through the invisible fourth wall. Little or no help is given towards the creation of a sense of intimacy by the audience grouping.

The second diagram indicates an extension of the main stage by the provision of a forestage. In this case the actor can be brought towards the audience beyond the confines of the proscenium wall. The audience, however, is still placed parallel with the stage in grouping which would give but little help in creating a sense of corporate participation in the performance. The Restoration theatres achieved the latter quality by using a similar plan but with shallow balconies around the three walls of the auditorium terminating in boxes on either side of the forestage.

The third diagram shows an entirely different arrangement with provision of an open stage set completely outside the proscenium wall and with the audience seated on three sides of the stage. Here the actor is within the auditorium in the position which he would have occupied in the Elizabethan theatre. The audience would have a keen sense of participation in the play and individuals helped towards a consciousness of being members of an audience.

The fourth diagram illustrates an auditorium wholly surrounding the stage as in a circus or at sporting tournaments. Here the actor is seen from all angles with the audience forming a background to his actions.

If a choice is to be made from among these four arrangements, which is it to be? It has already been concluded, though not without some temptations to the contrary, that the solution is to be found not in some revolutionary form (as, for instance, the last of my four illustrations) but rather by evolution or development from known and accepted theatrical forms. In an analysis of the development of the theatre is found a continuous progression of solutions each governed by the conditions of its time and each with variants to meet such conditions. No lasting movement has sprung from unrelated thought and only transients have been the product of a conscious desire to create a form out of a vacuum.

From what point, however, should one start? The rigid picture frame is still the most commonly accepted theatre form, a fact which cannot be ignored. On the other hand, to make that the starting point would seem retrogressive to the Questors, who had for all practical purposes abandoned the picture frame ten years ago. Each of the arrangements described might have contemporary validity—indeed each is an existing form of theatre.

At this point the case for an adaptable theatre was considered. It should be understood that the purpose of such an adaptable theatre is not for the production of old plays on the kind of stage for which they were written: Shakespeare on an Elizabethan stage; Sheridan with an eighteenth-century apron stage,

Ibsen in a picture frame, and so on. A theatre designed for that purpose would be of academic interest only and would be unlikely to give stimulus to the playwright of to-day. In the theatre the drama must be re-interpreted for each generation in terms of its own time. An older play performed exactly as it was originally produced would fail to have the same effect on an audience of to-day and therefore the new theatre, while providing for the production of such plays, must do so in a contemporary manner and not by imitating the past styles of playhouse form.

The case for an adaptable playhouse is rather that at this moment, when the theatre is in a state of flux, it is not yet possible to determine with certainty what kind of playhouse is wanted. Therefore it is desirable to have two- or three-in-one in order to experiment with them all and thus to discover the line along which to develop. This seemed particularly to apply in the case of the Questors who were quite deliberately offering themselves as a guinea pig. The conclusion was reached that there exists a convincing case for an adaptable theatre and the instructions given to the architect specifically stated that the new playhouse must be flexible in a contemporary way. By that was meant that the theatre must be adaptable to a full range of contemporary methods of staging rather than to the various styles of the past. The degree of flexibility required a stage-auditorium relationship to permit productions on

(*a*) a picture frame stage with the acting area confined wholly within the proscenium arch;
(*b*) a proscenium stage with a forestage;
(*c*) an open stage;
(*d*) an arena stage.

Site conditions play an important part in controlling any architectural concept, not only from the planning point of view which, in itself, is complicated by Acts, Regulations and Byelaws, but also from the æsthetic aspect. In the case of the Questors Theatre it was found desirable and possible to plan the Playhouse as an entity separated from all ancillary units. This is particularly satisfying architecturally, because it allows the theatre to express its own essential form and in this country there are but few examples of theatres which have been designed in this way. The majority of theatres can only be viewed as a façade.

The basic shape of the auditorium was first established by resolving such practical problems as the angles of sight lines necessary for uninterrupted vision, the direction of the seating to provide comfortable posture for each stage use, the local authority Byelaws and their concern for widths of gangways, the number of seats in each row and the position of entrances and exists. It was also necessary to evolve a shape capable of giving the actor-audience relationship previously mentioned for each use without destroying the sense of unity of the whole.

The question of compromise was very much in mind at this stage because the result of endeavouring to provide one basic plan for four distinct uses could easily be the failure to give a satisfactory solution for each. The Questors had

decreed that, whereas with the picture frame stage some degree of compromise would be acceptable, no compromise would be allowed with either the proscenium stage with forestage or with the open stage. They were prepared, however, for some improvization in the formation of the arena. It was found that a semi-ovoid planned around a small pit area would give the basic plan shape and, once this form was established, the stage area was designed as a complementary unit.

To achieve the desired degree of flexibility it was considered that whichever form the proscenium wall took it should be capable of providing any width of opening between the walls of the auditorium. This led to the design of metal screens sliding in tracks hung from above. The screens, which could be either manually or mechanically operated, could be readily moved into stage use or parked in the wings. Further consideration towards this end led to the idea that the small stepped pit area could be filled with moveable platforms, thereby providing a forestage and, if extended over the whole area, an open stage could be formed. When not required for stage purposes, the pit would accommodate seating and the platforms stored beneath the main stage.

At this time the design of the lighting gallery was clarified and it was established within the ceiling over the auditorium and the main stage. The shape of the gallery, following the plan of the auditorium and of the stage, forms two voids in the ceiling separated by a bridge situated over the proscenium line and from which the metal screens could be hung. The lighting from this gallery and the bridge could be directed from any angle towards the stages.

Whilst the various factors were crystallizing into definite plans, it had to be borne in mind that the essential quality of 'theatre atmosphere' must not be surrendered and that the ultimate design must suggest a place of entertainment and not a workshop.

Let us now consider the picture-frame stage, remembering that as each plan form is examined for each different use the Playhouse has been designed as one theatre and that the order of the plans is of no significance.

The development of the picture-frame stage has a very long and interesting history, growing from the proscenium of the Greek and Roman amphitheatres to a recognizable form in the Italian Renascence Teatro Olimpico at Vicenza. Here the semi-eliptical auditorium faces a stage framed by columns with a permanent proscenium at the rear. This proscenium perforated with five openings was obviously very restrictive and in later theatres the central opening was enlarged and framed with an architrave as in the eighteenth century Scala at Milan.

The plan for the Teatro Alla Scala, Milan, gives better sight lines than the previous example and the sense of audience participation is enhanced by the introduction of the boxes encircling the auditorium up to the proscenium wall. The late nineteenth- and early twentieth-century English theatres have picture frame stages, usually with encircling galleries terminating in one or two tiers of boxes adjacent to the proscenium. Thus a degree of intimacy was retained between the actor and the audience. The failure of designers in the years between

the wars to appreciate the necessity for this quality resulted in the elimination of boxes and of theatre plans little or no different from those of the cinema.

The picture-frame stage designed for the Questors consists of six rows of tiered seating with the rear row enclosed to form boxes to assist the creation of theatre atmosphere. Seven rows of tiered seating are placed in the pit parallel with the stage. Three further rows of seats are accommodated in the balcony which encircles the auditorium and terminates on the line of the proscenium.

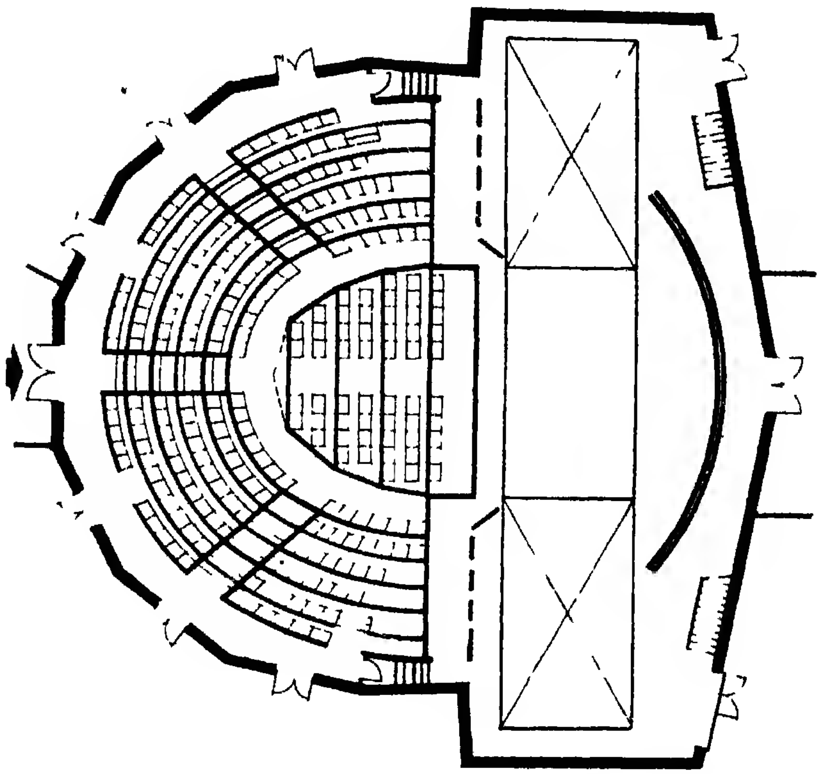

FIGURE 2. *Picture-frame stage*

The picture-frame opening is formed by the metal screens which are slid into position parallel with the front of the stage to give any desired width of opening, although it is anticipated that an opening 24 feet wide by 20 feet high would normally be used. The innermost screens are articulated to form tormentors should they be needed. The acting area can be permanently set or changed by means of the wagons. The stage is fully trapped to give access to the basement below. The rear of the acting area is enclosed by a permanent cyclorama behind which is the access to the dressing rooms, wardrobes and workshops *via* a fire-check lobby. The seating capacity for this use is 337 and of course is determined by the sight lines.

The second use of the theatre, that as a proscenium stage with forestage, is obtained by removing one or more rows of seating from the pit and extending the stage thereover towards the auditorium. The forestage thus formed can be of

any depth but standard sections of platform have been designed in five feet multiples. The access to the forestage is from either side, from the main acting area or *via* stage openings from beneath as the standard platforms coincide with similar sized removable sections in the floor of the pit. It is possible to vary the height or the shape of the forestage by the use of rostra of differing dimensions.

The forestage is not intended to be used only whilst sets are being changed on the main stage but as an extension of the main stage. This being the case it is necessary for scenery to be erected thereon and to be changed. This is possible by reason of openings formed in the metal screens and which are capable of receiving door sections or flats.

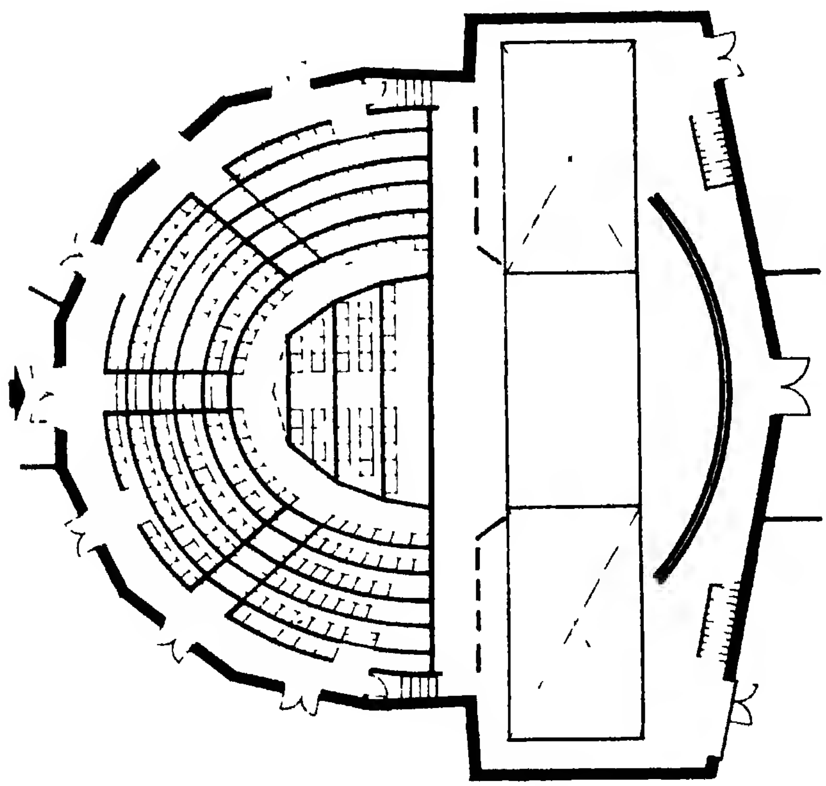

FIGURE 3. *Proscenium stage with forestage*

The seating capacity for this use, with the ten feet wide forestage, is 315, and the arrangement gives the producer an acting area in close contact with the audience for scenes requiring greater intimacy than it is possible to obtain in a picture-frame stage. It is interesting to consider this plan with that prepared by Wren for a Restoration Theatre. The semi-circular auditorium, with boxes around the perimeter, extending to a large forestage with a square main stage at the rear, would have made a most exciting theatre. Before considering the other uses I think it would be advantageous if I were to describe the longitudinal section through the new Playhouse.

The drawing (Figure 4) shows the tiered seating in the main body of the auditorium and in the small pit together with the three rows of seats in the balcony. The latter has been designed to ensure completely uninterrupted vision for all stage uses and encircles the perimeter of the auditorium. The tiers in the balcony have been restricted to three, as a larger number would result in too steep a rake as the sight lines must be described from the front of the open stage. In a larger theatre, with a balcony further from the open stage, the rake would, of course, be modified.

The floor of the pit is removable in sections so that access can be obtained to the area below the stage whenever the pit is covered with the platforms forming the forestage or open stage.

The lighting gallery over the auditorium and the stage is shown with the voids through which the lighting will be projected. For such uses as the open and arena stages it is necessary that the lighting should be from as vertical a source as possible, to avoid the light shining into the eyes of the audience. The main lighting source is from these openings, augmented by lights behind louvred openings in the ceiling. Such openings over the stage area behind the proscenium would be used for suspensions, although it is not intended that a full grid for flying scenery will be required. The lighting control system will be installed in the gallery and remote control extended to any part of the gallery. The bridge formed between the two openings in the ceiling is not only to be used for lighting purposes but supports the sliding gear of the metal proscenium screens. The lighting gallery will also accommodate the air extraction plant and the roof thereover contains sliding panels complying with the regulations governing natural ventilation.

Should an orchestra be required, it could either be placed within the pit area, particularly when an opera is being performed, or it could be stationed in the gallery.

The third use, that of the open stage, is obtained by removing all the seats from the pit and filling the area with the standard platforms previously mentioned.

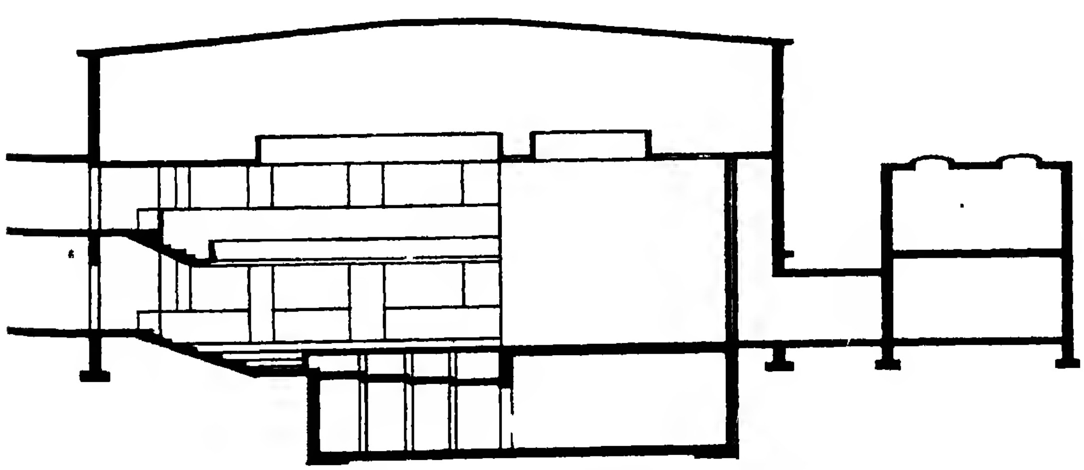

FIGURE 4. *Longitudinal section*

Additional seating is introduced at the sides, which more than compensates for that lost from the pit. The open stage thus formed is at a level one foot six inches above the floor of the surrounding tier. Shallow steps are placed around the perimeter of the stage to facilitate the grouping of the actors. Access to the stage is from any of the gangways, from the main stage, or from beneath

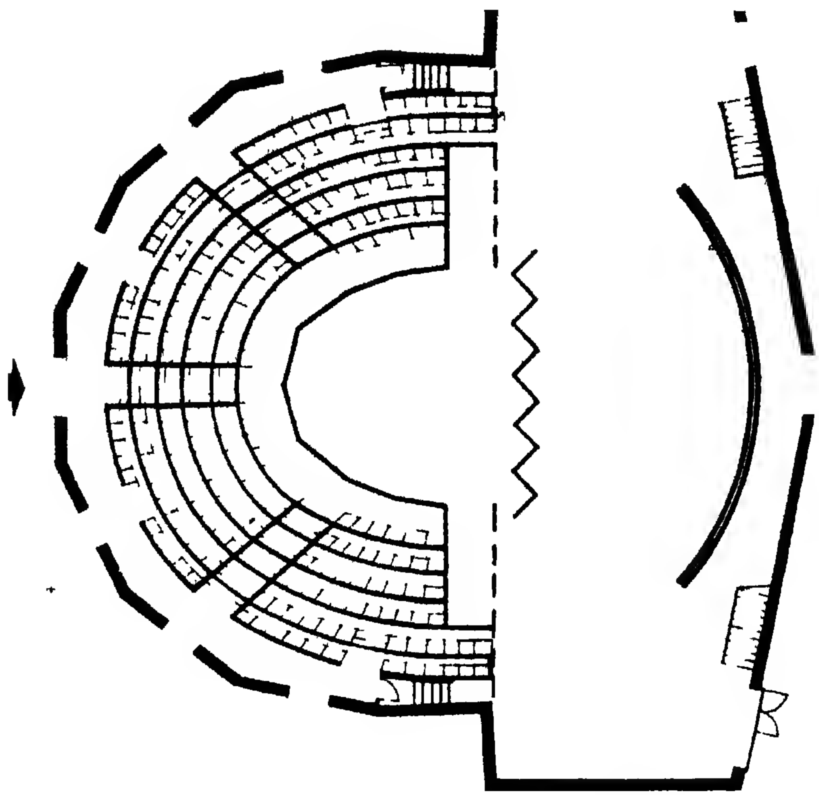

FIGURE 5 *Open stage*

Any section or sections of the platforms used for forming the open stage may be omitted, thus giving access to the basement through coincidental openings in the pit floor. The rear of the acting area could be enclosed by some form of set established slightly upstage of the proscenium opening. There have been many notable productions upon open stages and it is hoped that this plan will enable the capture of that vital actor-audience relationship which characterized the Elizabethan theatre. The seating capacity for this use is 359.

An arena stage is formed by sliding the metal screens away from the front of the stage and parking them in positions along the o.p. and prompt side walls. This completely opens the main stage area and, from within the cyclorama cavity, curved panels are withdrawn to join the main structural walls. These panels, together with the cyclorama, provide a background in front of which three rows of tiered seats are placed to complete the enclosure of the arena stage

Access to the stage is either *via* the openings between the seats or from beneath the stage. This arrangement would ensure a high sense of audience-participation and would be invaluable for certain types of play or spectacle produced wholly in the round. The seating capacity is 461.

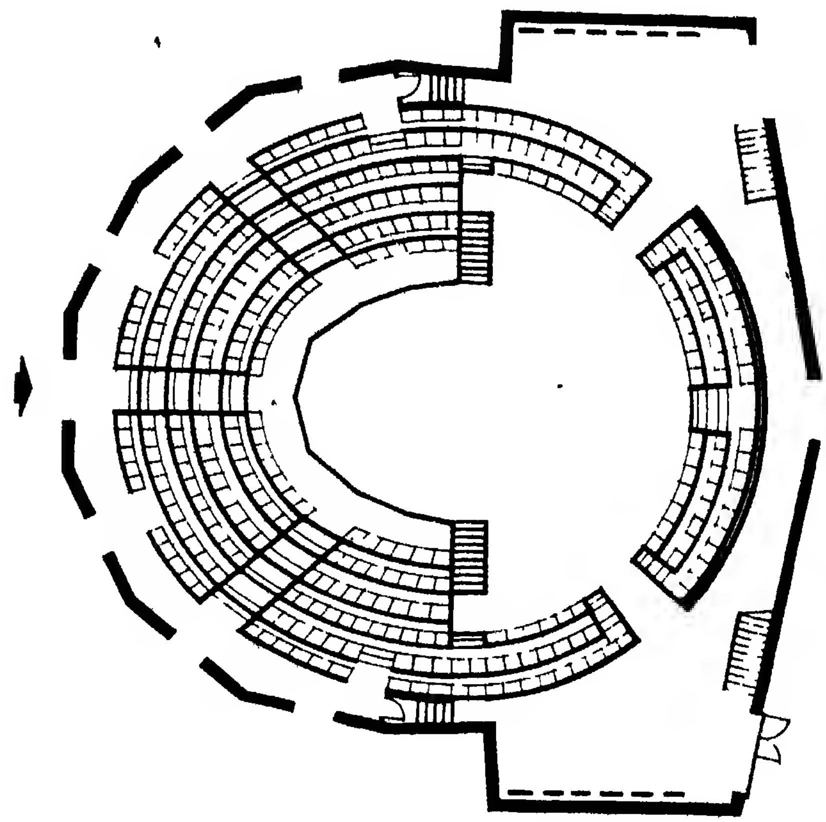

FIGURE 6. *Arena stage*

When the planning of the Playhouse had proceeded thus far it was found that a further distinct use could be obtained from the facilities already created. This is particularly interesting because it suggests that the basic design is capable of greater flexibility than originally envisaged, and in the hands of an imaginative producer still further uses may be evolved. The arrangement has been christened the 'space stage' and is formed by clearing the main stage area and extending the curved panels from the cyclorama to a point five feet from the structural walls, thus providing a semi-circular stage enclosed by an horizon. In the auditorium, the seating may be returned to the pit, giving a capacity of 397. The playing area thus formed enables the producer to create his production with complete freedom of style and to incorporate therein an essential theatrical use of space.

A mediæval mystery play, with the mansions surrounding the semi-circle of the acting area, and in which simultaneous action must take place would be one such use; another would be the use of an extended naturalistic set with both

interiors and exteriors. It is also possible to envisage an entirely abstract setting surrounded by the cyclorama and with the acting area defined only by light. A multiple set could be constructed and a revolving stage introduced. Another possibility to be explored would be the mobile set based upon Gordon Craig's screens and similar to that used in a recent production of *King Lear*, but with greater regard for spacial relationships. Lest it should be thought that this arrangement of stage and auditorium is without precedent, comparison should be made with the design produced by Inigo Jones around 1630 for the Cockpit-in-Court. The octagonal auditorium gives a fine sense of enclosure and the stage is backed by a semi-circular façade.

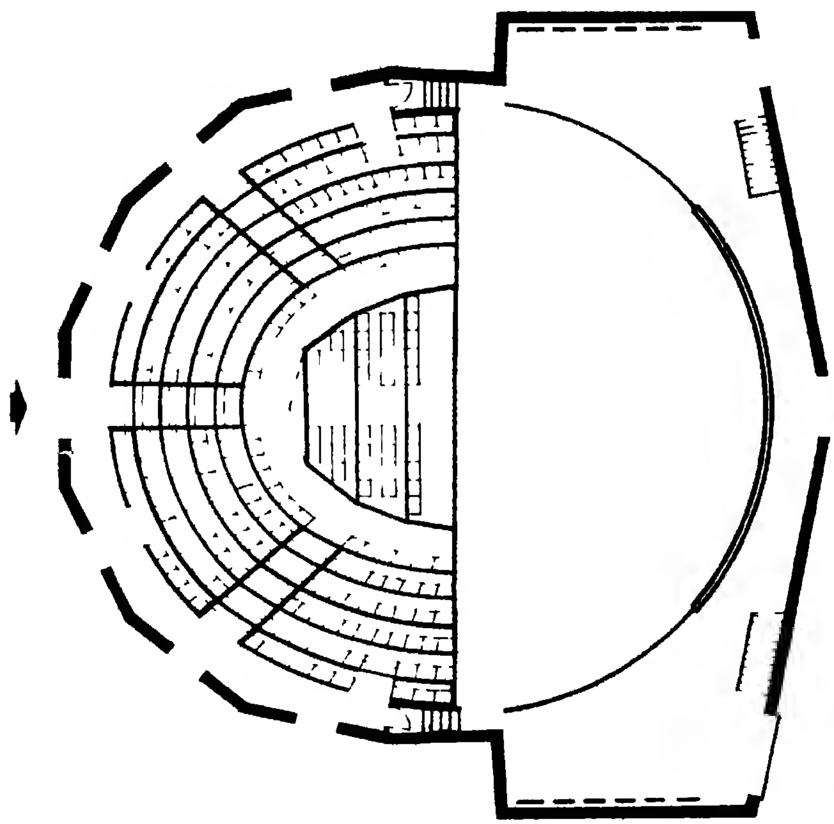

FIGURE 7. *Space stage*

A sketch plan reputed to be by Wren should also be compared because, although it is something of a rogue and bears no relationship to any known theatre, it shows a remarkably clear-sighted solution of the problems of theatre design. The audience are seated in semi-circular tiers and the radius used is continued into the stage area to describe the perimeter of a semi-circle of periaktoi.

The general arrangement of the stage area designed for the Questors Playhouse is best illustrated by an isometric drawing. This shows the method of constructing the removable floor of the pit and the platforms forming the forestage,

and the open stage. The sliding metal screens providing the picture-frame opening are designed to allow the insertion therein of doors, decorated flats, scenic panels, and so on. The cavity within the cyclorama which contains the curved panels is also shown together with the set wagons. The lighting gallery and the bridge are approached from a stairway at the rear of the main stage.

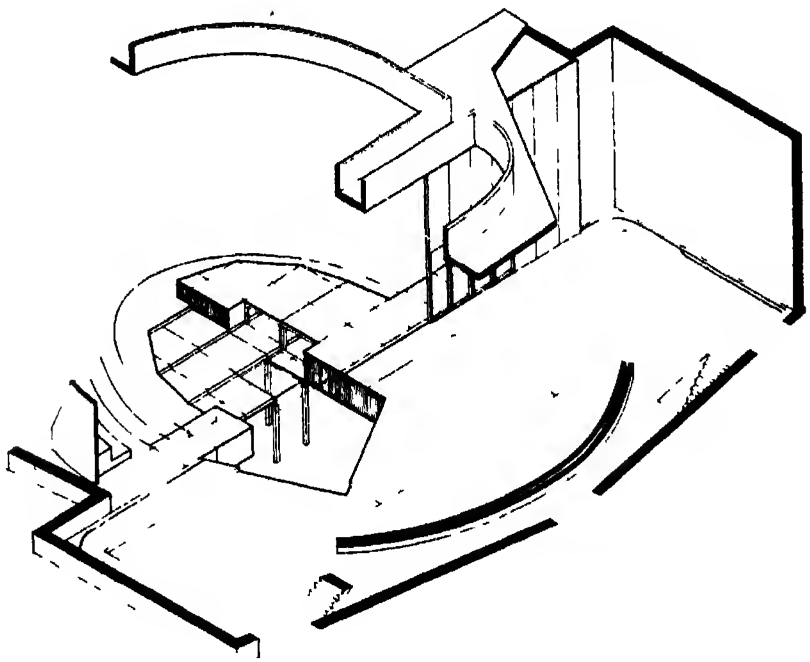

FIGURE 8. *General arrangement of stage area*

In this search for a new concept in theatre design, I have tried to discover what traditions are of significance to us to-day, what contemporary thought is based upon mere rootlessness, what compromises are invalid and what compromises have the power of development within them. The adaptable theatre is not necessarily the final solution—indeed, no solution can be a final one. Playhouse design must change and develop in the future as it has in the past. Our present dilemma arises precisely because of the absence of such development in the past eighty years or so. This concept, therefore, is to be regarded more in the nature of an experimental playhouse where the results may lead to the continuance for a time of the flexible theatre as itself answering contemporary needs, or it may lead to the rejection of certain of its uses and to the development of others. The Questors and I have not attempted to choose for the theatre but we have tried to take an important step towards restoring to the theatre a freedom of choice.

DISCUSSION

MR. EMILE LITTLER: Had the lecturer any thought of the possibility of this scheme's being adapted to the practical needs of a theatre holding, say, 1,600 people? It is not as a rule financially practical to run any theatre which only holds 300.

I would like to know if it is possible to use this scheme for a theatre holding 1,600, and to use it for musical production as well as for straight plays. Does the lecturer think that it is possible to run a musical play with the conductor away in the gallery? Does he think that this method of theatre design will in time be used for national playhouses such as the Memorial Theatre at Stratford-upon-Avon?

THE LECTURER: I think it is possible that the flexible theatre can be designed for the audience capacity which you mention. At the moment we have only given consideration to the Questors' specific requirements. For instance, you will notice the rather free way in which we extend platforms, and that is because the Questors have no labour trouble, but is possible for the platforming to be mechanically operated by simple means. I certainly do think it is possible to design a theatre—a flexible theatre—as a commercial venture. We would certainly have a battle with local licensing authorities before we got there. The Questors have offered themselves as guinea pigs already to Middlesex County Council, and the lists have been joined.

For musical plays, I did say that it was possible for the orchestra to be within the pit area. I had not thought of a musical play or an opera with the conductor way up in the gallery trying to give the beat to a singer on the stage. In suggesting that the orchestra could be up in the gallery I was thinking of occasions when music incidental to the play is used. With a musical play or opera, then of course the orchestra would have to be in the pit area.

MR. EMILE LITTLER: The moment you start to bring the actors out into the stalls, when putting area platforms up, it becomes necessary to move the circles back for sight lines. In putting in a larger audience the galleries or balconies would have to go back. Would this not mean the loss of a certain amount of seating in the house?

THE LECTURER: I think one would find that the difficulty, as I see it, of a large commercial theatre is that one week it may have a large musical company production, and the following week *Private lives*, but there are still those 1,600 seats. I rather think you will find that the audience for certain types of more intimate play would be smaller, therefore an open stage production could easily be used, and the sense of intimacy retained. Where you have the big spectacle, then it is possible that it could be better housed behind the proscenium. That could be done with this theatre because it is possible to change about in that way.

MR. EMILE LITTLER: I cannot agree that the size of the company of any kind bears any relation to the size of the audience. You can have four people on the stage and have a full house, or you could have 400 on the stage and four people in the audience!

MR. BENN W. LEVY, M.B.E.: This theatre that Mr. Branson has devised seems to me such an admirable plan that it would be excellent if it could indeed be adapted to bigger audiences. The difficulty that occurred to me is that he has designed the theatre at present for a proscenium opening of about 24 to 26 feet, which is about the normal size of many West End theatres. Surely, by the nature of his design, it is not impossible to increase the auditorium area without increasing the proscenium opening, or at least having impossible sightlines. Given an audience of 1,000 or 1,200, what size proscenium opening would he find himself involved with?

THE LECTURER: The proscenium opening which I suggested as being 24 feet was just a guess, because it can be adjusted to any width between the structural walls, so it is possible to have it sixty feet wide if needed.

MR. BENN W. LEVY: But how small can it be?

THE LECTURER: There will always be the problems of cut-off from the sides, but

at the Questors we lose relatively few seats. Obviously, in a larger theatre the more seats there are around, the greater number you would lose where the normal opening is 26 or 30 feet. That, I am afraid, cannot be avoided.

MR. BENN W. LEVY: Then how far does that rule it out for a theatre of 1,000 or 1,200 people?

THE LECTURER: I do not think it does, because at the present time you have the fan-tailed shape of theatre.

MR. BENN W. LEVY: There is a great deal of space without seats at the sides in this conception though.

THE LECTURER: I think it is possible to design some form of screening for those open spaces. What I was thinking, when Mr. Littler mentioned this, was the screens which have been thought about for the Questors. With the commercial theatre of the present day, which is fan-shaped, there is in fact that cut off area in the auditorium.

MR. EDWIN M. LAWSON: Do the promoters carry with them the powers that be? I cannot quite see how it is going to be possible to extend the stage into the auditorium and at the same time meet the whole requirements of the Licensing, Fire, and City authorities. How is that part of the project going to be overcome?

THE LECTURER: The Questors are offering themselves as guinea pigs in this case, and they are tussling with the local authorities on this very point. There appears to be no objection by the local authorities to our playing outside so long as there is nothing inflammable on the stage area beyond the proscenium. Also, I think, they would be very happy indeed if the proscenium, instead of coming down as the normal fire curtain does, were in fact to be the fire curtain, travelling horizontally. They certainly seem to have no objection to that, so therefore we can meet them in that way. The only difficulty at the moment is that we have yet to persuade them that in a modern theatre the auditorium itself in a far greater fire risk than behind stage.

MR. GEORGE POSFORD: Talking in terms of a larger theatre, particularly of a musical production, can the lecturer tell us if any provision is made for sound amplification electronically, bearing in mind the terrific development in recent years of sound amplification stereophonically?

THE LECTURER: I would have thought that in the theatre, as distinct from the cinema, the last thing one wants is mechanical sound. It ought to be possible in a theatre which is designed acoustically correctly for the actor or singer to make himself heard right at the back of the gallery. I had not thought of it at all I can assure you.

MR. GEORGE POSFORD: In effect, though, most musical productions now have a certain amount of amplification. I am not talking of real singers! I am not talking about opera, that is entirely different. I am referring to the fact that most singers in musical comedy have to have some sort of amplification.

THE LECTURER: Mr .Littler would probably know more about that than I do, but I think that Mr. Christie would agree with me, and that he does not have it at Glyndebourne. I do not think it should be anywhere else.

MR. JOHN CHRISTIE, C.H., M.C.: If there is an arena stage in the middle, the actors will be continually with their back to parts of the audience, and I should have thought that there was a difficulty here. I raise this point because the Old Vic's performance of *Macbeth* in Edinburgh was so bad that I went out after the first act. They were simply shouting at each other. The beauty of the words did not count. How

Shakespeare can be performed without the beauty of the words, I cannot imagine. But if that is the tendency of the present day, it may do.

The arrangement of the seats is again a challenge. The seat-fitting people, who supply the theatres, had never had this experience before, but at Glyndebourne they were faced with it. Sitting in the middle of the audience, one wants to see the chairman in the centre of the stage, and to look between the two people in front of one, otherwise the view is obstructed by the head of the fellow in front and one cannot see anything. I want to have a clear view. Now at the side of the audience, when I am directly behind the person in front, again I look between him and the next person and therefore still see the chairman in the centre of the stage. That problem had never arisen. They did not even know anything about it. If you put your seats on a curve, you cannot deal with the problem. Perhaps it does not matter. It does matter at Glyndebourne. Everything has got to be right!

There was no mention as to where the lighting control was to be. I can only tell you that in the theatre in Edinburgh, where we had to perform, a new system of lighting was put in at great expense. The lights came on and went off for no reason at all. Why should we be distorted like that? It is intolerable. There is no standard and where the lighting control is to go is all important. It must be in front. It cannot be moved about and you cannot have a little consol with tiny handles. How can sensitivity be achieved, moving handles only about two inches long. Our handles are long. Sensitive control cannot be achieved unless they are of some appreciable size.

I noticed that on the drawings the cyclorama was only the same size as the scenery. Supposing we are on the stage holding up scenery, the cyclorama should be at least another 15 feet away from its present position or there will be shadows. That is a mistake that Glyndebourne made which cannot be corrected. I know there is quite a lot of feeling about it. That is a technical point, but you do need the extra space for the cyclorama. It has to be outside everything, it is like the sky. Also, it is used for projection, you can project on to it. I am sorry to take so long in giving these views, but I want to be critical in order to help.

THE LECTURER: May I say that I have spent some very happy hours at Glyndebourne learning from Mr. Christie, and we are not making any of the mistakes which he suggests we are, because we have learned from Glyndebourne! In the first place the seats will be very carefully articulated, so that it is possible to have the Glyndebourne arrangement of perfect seating. The lighting control is within the gallery as I mentioned, and the control will be longer than the two-inch handles that Mr. Christie mentioned. I think that the cyclorama is of adequate dimensions, and of course with the space stage the cyclorama is all round—it could not be bigger.

The production of *Macbeth* which you mentioned was on the open stage at Edinburgh. Frankly I liked it much better than the Old Vic's same production on their fore-stage, as I felt that was very cramped, but I do agree with you they raised their voices; but they also raised their voices intolerably at the Old Vic. I do not think it had anything to do with the stage!

MR. EMILE LITTLER: Mr. Ben Levy's remarks might suggest that I am being critical, but I would like to assure the lecturer that I have come here to learn from him, and that any observations I have made are in a constructive way.

Over twenty years ago I had the honour of battling with the Birmingham Repertory Theatre as manager for three or four years. The seating capacity was under 600 people and a lot less than £100 per performance. We had a very tough battle even in those days with so few seats. I know what trouble Mr. Christie must be having at Glyndebourne with his small capacity.

With regard to the necessity of cyclorama being as far away as possible from the

proscenium, it was during my time at the Birmingham Repertory Theatre that Sir Barry Jackson took the cyclorama out because there it was too close and, as Mr. Christie has said, we could not throw light on it without shadows. We took the cyclorama down and plastered the back wall and sometimes used that instead. Actually we gained another six feet of stage depth, which was a help with all productions. I consider the size of any theatre built to-day is a very important matter in relation to the economics of running it. I have enjoyed the paper, and one day would like to see the same plans worked out for a theatre seating 1,600.

THE LECTURER: I would like to thank Mr. Littler for what he said for I know it was meant entirely in a constructive way. I too would like to see these ideas which have been evolved for this specific theatre carried one stage further, because I am quite convinced that they are capable of extension to a larger theatre, bearing in mind the economics to which you have referred.

MR. PETER GOFFIN: I appreciate very much the fact that the little theatre is an experimental one and therefore ought to be as flexible as possible in order to try out all the possibilities. I feel, however, in its capacity as an ordinary theatre, using the proscenium arrangement, that the plan lacks a flying system of some kind which is useful, and perhaps essential, for certain types of production. If a flexible theatre such as this could be built on a larger scale it should also include the usual facilities so that it could be used for the ordinary type of productions as effectively as for those using any of its other forms. I wonder if the lecturer had thought in these terms on a larger scale, and whether the inclusion of such facilities would in some ways spoil, or lead to a need for modifying, the present scheme.

Concerning lighting, I was not so much concerned with the position of the switchboard, although I do agree entirely with Mr. Christie about the small-size control system. I am concerned more about the actual lamp positions, which at present are mainly in the roof. It will therefore have to be mostly top lighting. It did seem to me, in connection with the space stage, which is perhaps one of the most interesting ideas, that it would be very difficult in some cases to get lanterns housed in strategic position without losing the effect by having the machinery in view

THE LECTURER: The Questors do not wish to have facilities for flying. They are concerned only with the use of the wagons for changing, but it is possible to extend a grid over the stage, and I do not think that it would unduly affect the arrangements at the back. Lighting does want very careful consideration and we are in fact planning most carefully for it. We have lighting at any point around the perimeter of the stages—that is very important. Lanterns could also be mounted on the front of the balcony. We have not got footlights, but they could be introduced if necessary with a proscenium type of production.

MR. PETER GOFFIN; The difficulty, I feel, is that in the average ordinary proscenium theatre to-day, most of the lighting positions are in fact the least useful places for lights, and one of the real snags in the theatre is to find the best possible places to put lights for different kinds of productions. It is sometimes a great advantage to do away with the front lights, but their positions on the stage itself must be used. It seems to me that the space stage lends itself admirably for experiment with lighting, but unfortunately has not, in a sense, made provision for it.

MR. EVAN DAVIES: In connection with this small theatre, has the lecturer had an opportunity of studying an equally small new theatre: St. Erasmus, in Milan? There the stage is on the floor of the theatre, and the audience is seated on both sides there being no directly front-stage audience.

THE LECTURER: I have seen the plans cf that particular theatre.

MR. EVAN DAVIES: This new theatre, experimenting on entirely new lines, provides what we are all trying to achieve, 'an atmosphere of intimacy'.

I do not think that large theatres can provide the same atmosphere as small ones, nor do I think that a small theatre design is suitable in terms of a larger theatre, seating three times the number of people, where distance from actor to audience is greater and mechanical means of amplification have to be used.

This Italian theatre in Milan is a very interesting example in theatre design. I wondered if the lecturer had actually studied such an experimental work.

THE LECTURER: No, I have not seen it, I have just seen some illustrations.

MR. HENRY ADLER: This scheme sounds excellent mathematically and architecturally, but I have seen some of these theatres which are amendable in relationship to actor and auditorium. I feel that there is not the feeling with this theatre. It is all beautifully worked out, yet the relationship or atmosphere is somehow lacking. Has Mr. Branson any plan for the relationship of audience to actor, and arising out of that, the decoration of the theatre, or the feel of the place generally?

THE LECTURER: As I mentioned in my paper, this has to be a place of entertainment, it has to be theatre, and it has to have theatre atmosphere. Nothing is worse, I entirely agree with you, than something rather like a cocktail cabinet which looks like a book-case and then when you open it, it is not a cocktail cabinet but a radiogram. That is why I introduced those little thin columns in front of the boxes. The idea was that by those columns, by closing the rear rows of seats in pew boxes, and with some nice materials of the right colours, theatre atmosphere, which is so essential, would be achieved. No matter what the stage use, that is the important thing. We would try most definitely with decoration—not forgetting red plush and a bit of gilt around the place—to retain that. It is realized that the quality to which you refer is an essential factor of the design.

MR. PATRICK IDE: How does the lecturer mask the top of the cyclorama if he cannot have a border? I could not see from the drawings how it was done.

THE LECTURER: The cyclorama goes straight up to the ceiling and stops there. The ceiling is painted quite dark, preferably black.

THE CHAIRMAN: I want to propose a vote of thanks to the lecturer, because I feel that the way he is going into this matter is thorough. That is a very valuable asset in anything that is going to take a practical shape. I hope earnestly that it will take a practical shape. He has given us a clear idea of what he, Mr. Emmet, and the Questors are aiming at, and all I can hope is that they will not find as much difficulty in getting the finance to complete the scheme as I had with the Vanburgh Theatre at the Royal Academy of Dramatic Art.

The vote of thanks to the Lecturer was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

THE WORK OF THE COLONIAL DEVELOPMENT CORPORATION

The Thomas Holland Memorial Lecture by

H. NUTCOMBE HUME, C.B.E., M.C.,*

Deputy Chairman of the Colonial Development Corporation, *read to the Commonwealth Section of the Society on Thursday, 12th April, 1956, with the Right Honble. Lord Milverton, G.C.M.G., in the Chair*

THE CHAIRMAN: Mr. Nutcombe Hume is eminently the person to give us a talk on this subject. He has been on the Board of the Colonial Development Corporation since its initiation and he can tell you about it, and answer any questions which you may care to ask him. I am sure that he will give a very satisfactory account of the way in which the Corporation has now been steered into calmer waters. I have no intention of encroaching on his preserves and I am not going to say anything at all myself about the Corporation, but I have been asked to say a word about the Thomas Holland Memorial Lecture.

The lecture was founded in 1951 by Sir Thomas Holland's widow to commemorate her husband's long association with this Society, of whose Council he was a member for very many years. He was head of the Geological Survey of India and a member of the Viceroy's Council for Industries and Munitions. The lecture is normally concerned with some subject relating to the industrial or educational development of the Commonwealth, and the subject this afternoon is one which still maintains an intense interest. We know Mr. Hume as a very eminent chairman of various businesses in the City of London, but this is one of his other manifestations. May I hasten to say that I do not mean to imply that the Colonial Development Corporation is not run on business lines?

The following lecture was then delivered:

THE LECTURE

In May of last year, Sir Hilton Poynton gave an interesting and comprehensive survey of the whole field of colonial economic development (*Journal of the Royal Society of Arts*, Vol. CIII, p. 905). He made only a passing reference to the Colonial Development Corporation because he was describing many factors outside the Corporation's sphere.

The purpose of this lecture is to describe how C.D.C. fits into the general picture of colonial development; what is its particular task; how it is tackling it; the progress it is making and something of the experience it is gaining and the lessons it is learning.

THE COLONIAL DEVELOPMENT CORPORATION'S TASK

First of all let us be clear about the Corporation's *raison d'être*. Let me quote

* Now Sir Nutcombe Hume, K.B.E.

the actual words of the Overseas Resources Development Act, 1948. In Section I, the Corporation is

> charged with the duty of securing the investigation, formulation and carrying out of projects for developing resources of colonial territories with a view to the expansion of production therein of foodstuffs and raw materials, or for other agricultural, industrial or trade development therein.

In the discharge of this duty the Corporation is expressly empowered to carry on, or to promote the carrying on of all activities which appear to be 'advantageous or convenient for or in connection with' it. If this piece of Parliamentary drafting is analyzed, it will be seen at once how wide is the range of the Corporation's opportunities and responsibilities, especially bearing in mind the geographical spread and diverse character of the British colonial territories.

First—'investigation' (I will have more to say on this later); then 'formulation'; then 'carrying out'; 'expansion of production of food and raw materials'; 'other agricultural, industrial and trade development'. This is indeed a comprehensive mandate!

THE METHOD

The powers given to the Corporation in Section I of the Act left a sensibly wide discretion as to the methods by which its manifold tasks could be tackled. The Corporation can carry out development, including the processing and marketing of products, itself under its own direct management; it can establish or expand other bodies to do the work; or it can work in partnership with, and delegate management to, other bodies whether private enterprise or government authorities. I shall give examples of some of these alternative methods when I come to describe the Corporation's activities.

THE MEANS

The Secretary of State for the Colonies is authorized to advance to the Corporation sums the total of which outstanding at any one time does not exceed £100 million, and the Corporation is also empowered to borrow up to £10 million on short term. These loans form the capital of the Corporation, and interest on them is payable in accordance with rates prevailing at the date of each advance. The Corporation is by the Act required to ensure that its revenues are sufficient to meet its outgoings taking one year with another. It must pay its way like any other commercial concern and in addition it must pay interest on its capital and must repay the capital.

On long-term loans interest payments and capital repayments are made by 33 annuities beginning in the eighth year from the loan; on medium- or short-term loans, interest is paid as it is due and capital is repayable at the end of the loan period.

COMMERCIAL BASIS

I would like to emphasize this commercial discipline under which the Corporation has to work and to ask you to bear it in mind in connection with what I shall say later about the Corporation's activities and the lessons we have

learned. It marks the fundamental difference between the C.D.C. and the Colonial Development and Welfare Fund. There has, I think, been a little confusion in the minds of some people, both overseas and at home, as to the respective functions of these two instruments.

Money provided by Parliament under the Colonial Development and Welfare Acts (C.D. & W.) is used primarily to further colonial development of a non-commercial character. Projects financed by this means are those which, in the main, are not expected to show a financial return; their aim is rather to lay the essential foundations for wealth creation—communications, scientific research, public utilities, education, health services, and so on.

C.D.C. is an entirely separate organization; none of its funds come by way of grant monies and its projects must be such as will ultimately earn revenue to cover the payment of interest and repayment of capital on the terms I have just mentioned. It will be seen therefore that in selecting projects and in operating them C.D.C. must follow normal commercial principles and practice. Within, and inseparable from, the overall task of helping each territory to develop its economy, profit must be an essential criterion.

That is not to say that it is always easy to draw a sharp dividing line between what is commercial and what is not. In undeveloped areas projects have to bear heavy expenditure on public utility work on such necessary things as roads, housing and health services and this can lead to over-capitalization and can tip the scale against the marginal risks in which the Corporation deals. Furthermore, the application of commercial standards means that some types of development otherwise deemed desirable are ruled out of the Corporation field. The Corporation has, more than once, drawn attention to this and has suggested that some means be found, possibly by closer co-ordination with C.D. & W., to enable it to undertake work which, though unlikely to be financially profitable, is agreed to be a worthwhile contribution to a territory's economic development.

Having described the Corporation's task and the essential conditions under which it is being tackled I must go on to say something of the achievements and failures so far; also something of the lessons that have been learned. I think it will help to understand the picture more clearly if I first say a brief word about the Corporation's administration and about its relations with local colonial governments and people.

ORGANIZATION

The Board of the Corporation consists of a Chairman, Deputy Chairman and not less than four or more than ten other members, appointed by the Secretary of State for the Colonies 'from amongst persons having had experience of and shown capacity in matters relating to primary production, industry or trade, finance, science, administration, organization of workers or welfare'. The Secretary of State also appoints the Corporation's auditors and receives from the Board an annual report with a full statement of accounts which are presented to Parliament and then printed and published by H.M. Stationery Office.

Board members, including the Chairman and Deputy Chairman, serve on a part-time basis. The chief full-time executive officer, appointed by and responsible to the Board, is the General Manager. Under him at Head Office there are controllers with functional responsibilities for investigation, finance, and operations, each with a staff of experienced assistants. Overseas six senior executives are controllers of regions and are responsible for all Corporation activities within their respective areas.

In the early days of the Corporation a system of functional divisions was built up at Head Office, each with a qualified technical manager and staff. There were agriculture, forestry, mineral, and several other such divisions each controlling their particular projects from London. This was not found to be an efficient or economical method of control, and in 1951 there was a reorganization which resulted in the appointment of the regional controllers I have mentioned and in the disbanding of the Head Office technical divisions. Greater use is now made of outside technical and scientific experts, who are consulted as need arises, and the Corporation has also appointed an advisory panel of eminent agricultural scientists to whom problems of tropical agriculture are frequently referred. This reorganization, besides giving greater efficiency and better local relations, has resulted in considerable reduction of administrative costs.

The regions into which the Corporation's projects are grouped follow naturally from the geographical disposition of the colonies themselves. There is first the Caribbean Region, which of course includes all the British West Indies islands, the two mainland territories of British Guiana and British Honduras, and also the Bahamas. The headquarters of this region are in Barbados which is a convenient centre from which the Regional Controller can maintain contact with the various colonial governments, with the projects in the region and with the office of the Comptroller for Development and Welfare which is also in Barbados.

There is the Far East Region which at present has projects in North Borneo, the Federation of Malaya and in Singapore but which would also include Brunei, Sarawak, Hong Kong, Fiji and the Western Pacific Islands should projects be launched in any of those territories.

Then there are four regions in Africa. The East Africa Region, with headquarters in Nairobi, has projects in Kenya, Tanganyika and Uganda, and would also include Mauritius, Seychelles and Zanzibar. The West Africa Region covers the four British West African territories of The Gambia, Gold Coast, Nigeria and Sierra Leone; its office is in Lagos. There is a separate Central Africa Region for the Federation of Rhodesia and Nyasaland, and finally a region, based for convenience in Johannesburg, for the High Commission Territories, Basutoland, Bechuanaland Protectorate and Swaziland. One project outside any region is the Tristan da Cunha Development Co., Ltd., which is dealt with from London through the office of the company in Cape Town, but which in our reports is grouped with the High Commission Territories Region.

LOCAL ASSOCIATION

I will now say a word about the Corporation's local relationships which we

regard as most important. There is a negative provision in the Act which says that no project shall be encouraged in any territory until there has been adequate consultation with the local government concerned. This, of course, is only commonsense and in fact, quite apart from any statutory obligation, the Corporation has always maintained the closest possible liaison and consultation with colonial governments.

It is also the responsibility of Regional Controllers to see that good relations are maintained with local people and local interests. The Corporation is a business organization and its business relations must follow normal commercial principles and practice, but it has always in mind that it is an instrument of Her Majesty's Government for helping to advance the prosperity and well-being of the colonial peoples. By colonial peoples I mean all those who have their permanent homes in a territory irrespective of race or colour. Naturally the Corporation must keep clear of involvement in local political conflicts, particularly those arising from racial divisions and, in its own activities, it practises no racial discrimination.

It is deliberate policy of the Corporation wherever possible to enlist in its projects the active participation, both financially and in management, of local interests, whether governmental or private enterprise or both.

I want to say a special word about management later, but let me say here that wherever there are reliable commercial firms who have long experience, and an established organization for dealing with any particular line of development, we try to bring them in. There is sometimes a fear on the part of private enterprise that partnership with governments would lead to too much control and restriction, while on the governmental side there may be a feeling that commercial firms are only concerned with their own interests and that their activities must be carefully watched and checked in the wider interest of the community. C.D.C. is neither private enterprise nor government department; it can render useful service as intermediary, stimulating private enterprise and experience, and linking them with public resources and endeavour.

LABOUR RELATIONS

While speaking of local relationships it is perhaps appropriate to say a word on labour relations and employment policy. In the case of those projects which are directly managed by the Corporation it has always been the practice to co-operate fully with local government Labour Departments and to fix wages and working conditions in keeping with prevailing standards. On some projects much attention has been paid to the provision of welfare services like clubs, sports fields and cinema shows; where necessary medical services and housing have been provided, often in co-operation with the local authorities.

Trade unions are acknowledged wherever they have been registered and recognized under local laws. Where technical and supervisory skills have not been locally available attempts have been made to train local people, and although the possibilities of regularized training by means of schools and proper apprenticeship schemes are limited, several projects have been successful in 'training on the job'.

PHYSICAL ACHIEVEMENTS

Now I must say something of the Corporation's operations in the field of colonial development. There are at present 63 projects in hand for which a total of nearly £55 million has been sanctioned. Of this sum over £37 million has already been advanced and used.

It is not possible to go through every one of the 63 projects and describe them all in detail. They are all described and reported upon in the Corporation's Annual Report to the Secretary of State for the Colonies which is available from H.M. Stationery Office. I would like, however, to take one or two representative projects from each of the six regions and to describe what we are trying to do there and how we are getting on. Before turning to the regions there are two general features about all the projects that are worth noting—first, their functional diversity and secondly, their stages of development.

FUNCTIONAL GROUPING

The functional diversity of projects is shown each year in the Annual Report by a table giving the proportions of capital approved and capital employed under various heads. The functional grouping and proportions are approximately as follows:

	Number of projects	*Percentage of capital deployed*
Agriculture	12	20·0
Animal products	6	5·4
Factories	6	6·9
Fisheries	1	0·3
Forestry	5	12·0
Hotels	1	0·7
Minerals	10	13·0
Property and housing	7	10·9
Power	7	26·3
Transport and communications .	8	4·5

As the economy of practically every colony is based on primary production it is not unnatural that agriculture, animal products, forestry, and minerals account for more than half the projects. But it will be seen that there is a fair balance of investment in those projects which will stimulate further development such as those for power, transport and communications.

STAGES OF DEVELOPMENT

Broadly speaking the phases through which development projects have to pass are:

(*a*) research and/or exploration;
(*b*) investigation and/or prospecting;
(*c*) test by pilot scheme;
(*d*) development from pilot scheme to full-scale operation;
(*e*) commercial operation.

The Corporation cannot normally provide finance for general research and exploration, but at whatever stage a proposal is brought to the Corporation it is essential, before any major financial commitment is made, to know that the initial stage of investigation has been adequately done and that there is definite prospect that the project is likely to become commercially viable. Sometimes we have to start right at the beginning and on other occasions a certain amount of preliminary work has been done; but there are no occasions on which it can be dispensed with.

Full-scale production may not be reached until the project has been in production for some years. The period of initial trading, which itself may follow a long period of investigation and development, is a testing time for most new projects; losses at this time may quite reasonably be expected on a project that will ultimately be successful, and such losses can properly be regarded as part of the capital cost.

Let us now look at the regions and one or two of their projects to see how they are contributing to development. I will start with the Caribbean Region.

CARIBBEAN REGION

There are 18 projects in the British West Indies, British Guiana and British Honduras. The total capital employed in projects in this region is £6·5 million and a further £1 million has been sanctioned. Electricity projects in Barbados, British Guiana, Dominica, St. Vincent and Jamaica will undoubtedly serve to stimulate further development.

In the widely separated British territories of the region communications are an important factor not only in furthering greater economic progress but also in helping closer political cohesion. Contributions by the Corporation in this field are its participation with an experienced shipping firm in the new inter-island shipping service and the loan of £55,500 to help finance the construction of the new airfield on Grand Cayman. The inter-island shipping service started early in 1955 and is already meeting a long-felt need.

Primary production is being developed by gold, timber and rice projects in British Guiana, by the small but successful banana and copra estate in Dominica, and by a loan to the Citrus Growers Company in Jamaica to finance an extension of its fruit processing factory. A cooling store built and operated by the Corporation in Kingston is also proving of considerable benefit to Jamaican producers.

A problem that has proved extremely difficult and has given the Corporation great anxiety is the search for commercially viable means of helping the economy of British Honduras. A stock farm and a banana plantation were both, for varying reasons, unsuccessful and had to be discontinued. Similarly long and exhaustive, as well as expensive, trials have been made into the commercial production of ramie fibre; this also has been discontinued largely owing to the failure of the world market for ramie. Trials are, however, continuing in British Honduras with citrus and, on a small scale, with cocoa. Whether these can be developed beyond the pilot scheme stage will depend on the experience to be gained over the next few years and on the availability of labour. A successful venture in British Honduras has undoubtedly been the Fort George Hotel. Built and equipped on modern lines and maintaining a good standard of service, this hotel is proving a great asset to the colony in providing for tourist and business visitors.

FAR EAST REGION

The Corporation's projects in the Far East are in the Federation of Malaya, Singapore and in North Borneo. Proposals for projects in other British Far East territories have been examined from time to time but none have yet been found that were commercially practicable. There was for instance a very thorough and costly investigation into a hydro-electric scheme in Fiji.

The amount of capital at present sanctioned in the Far East Region is £15·4 million of which £13 million is employed. The largest single investment, over £7 million, is in the Central Electricity Board, Malaya, where the money advanced by the Corporation has been used for building the new Connaught Bridge Power station in Selangor. The Federation faced a grave shortage of electric power after the war and this use of Corporation funds helps to make possible much further general development and is an indirect investment in mining and other productive industry.

A highly successful project which operates in both Malaya and Singapore is the Malaya Borneo Building Society. It was formed in 1950 to help alleviate the acute housing shortage. Over £6 million has been advanced to nearly 5,000 individual owner-occupiers of new houses but apart from this the operations of the Society have shown a way of investing savings in better living without recourse to state control or subsidy, and have stimulated the building trade and its allied industries. Incidentally, the success of this project is having an influence beyond Malaya; the Society's advice on possible building society schemes has been sought from places as far apart as West Africa and Hong Kong.

Other projects helping to relieve Malaya's undue dependence on rubber and tin are an oil-palm estate where, unfortunately, progress has been hindered by the activities of bandits, and a pilot scheme for cocoa in partnership with a well-known planting firm and one of our leading cocoa firms. The cocoa pilot scheme has made good progress and is now on the threshold of considerable expansion to the commercial production stage.

The introduction of secondary industries in Singapore is being encouraged

by the development of an industrial estate on which four new factories are now in production.

In North Borneo the Corporation is developing former Japanese-owned rubber and hemp estates. There is a shortage of labour and this, together with a very worrying plant disease in the hemp, has made progress difficult but the rehabilitation and modernization of the estates are being pressed forward and new crops are being tried.

EAST AFRICA REGION

Capital sanctioned for projects in East Africa amounts to £13·3 million; the amount employed at the end of 1955 was £7·9 million. Of 13 projects in the region, eight are for investigating and developing mineral resources, mainly copper in Uganda, coal in Tanganyika, and copper, gold, silver and zinc in Kenya. The Kilembe copper mine in the Ruwenzori Mountains, in the development of which the Corporation is in partnership with the Uganda Development Corporation and an experienced Canadian mining firm will, with the consequent railway extension, materially assist the development of the Western Province of Uganda.

In the Southern Province of Tanganyika the Corporation has spent over £400,000 in proving the existence of exploitable quantities of good coal but its development awaits the provision of a railway link. With this, considerable development could follow in that area.

Another valuable contribution to Tantanyika's development is the wattle growing scheme at Njombe. Here some 30,000 acres are being planted with black wattle the bark of which is used for the production of tanning extract. Alongside the Corporation's own estate the local Africans are being encouraged and helped to grow 20,000 acres of their own wattle. A processing factory is now being built and the project will result in the introduction of a new crop and a new industry to an area where Africans previously were barely able to sustain themselves on soil which, though good for wattle is very poor for food crops.

As in most under-developed areas, the provision of electric power is a vital element of development in East Africa. The construction of the Owen Falls Hydro-electric Station has opened up great possibilities in this direction and to assist Kenya to take advantage of this source of power the Corporation has taken up £3½ million of the £7½ million debenture issued by Kenya Power Co., Ltd. This is in keeping with one of the main functions of the Corporation – to prime the pump of private investment.

Another interesting development in Kenya is East Africa Industries Ltd. in Nairobi. This was a small industrial plant started by the Government during the war. The Corporation took it over and subsequently enlisted the participation of Unilever Ltd., who now manage it. A margarine factory has been constructed and the possibilities of extension to soap and glycerine manufacture are in prospect.

CENTRAL AFRICA FEDERATION

At the time the Federation was established the Corporation was growing

tung and tobacco in Nyasaland and had, in partnership with the Northern Rhodesian Government, established a cement factory in Northern Rhodesia. It had made a loan to Central African Airways to finance the purchase of new modern aircraft, and a very thorough two years investigation had been made into the possibilities of commercial afforestation on the Nyika Plateau in Northern Nyasaland. Since Federation, loans have been negotiated for all three territorial Governments to help in their schemes for the better housing of Africans, a very necessary factor in economic as well as social development. Commercial associates have been brought in to Chilanga Cement Ltd. and the plant has been expanded to treble its original capacity. Development of the plantation projects in Nyasaland has gone forward but their ultimate success will depend very largely on the provision of communications and the securing of markets.

The total of Corporation capital now sanctioned for development in the Federation is £6 million of which £2·3 million has already been employed.

HIGH COMMISSION TERRITORIES

As yet the Corporation has no project in Basutoland. This is not because this Protectorate has been neglected; one or two proposals have been suggested but there have been none so far that have been found suitable for the Corporation's participation. In the other two territories, however, Bechuanaland and Swaziland, the Corporation has a total of £9·7 million sanctioned of which £5·4 million has been employed.

The major economic activity in Bechuanaland is, of course, the cattle trade and the Corporation is stimulating this by the development of ranching and by the *abattoir* at Lobatsi, which has introduced a useful and profitable industry to the Protectorate and enabled it to retain the proceeds from processing and by-products which formerly went to neighbouring territories.

By its large irrigation and afforestation projects in Swaziland the Corporation is helping that little country to make more fruitful use of its plentiful rivers and fertile land. Large areas of bush have been cleared, new crops are being introduced and the hills are becoming covered with pine trees which open up the possibilities of eventual pulp and lumber industries. All this means that the problem of a railway and better road communications for Swaziland is becoming increasingly urgent.

WEST AFRICA REGION

The Corporation's activities in West Africa are at present confined to the Gold Coast and Nigeria. There was, of course, the much publicized Gambia Poultry Farm but I am going to say a word about our failures in a moment, when I come to speak of some of the lessons we have learned.

Present operations in West Africa are mainly in the field of basic services. Roads and other civil engineering contracts are being carried out by experienced associated companies; there is also a loan to the Lagos Executive Development Board for land reclamation and development. The Corporation is helping in the utilization of Nigeria's timber resources by its participation in Ome Sawmills of Nigeria Ltd., which operates a new modern sawmill in the Western Region.

Capital sanctioned for these projects to date is nearly £3 million, of which £2·5 million is employed. The Corporation would welcome further opportunities of working in West Africa in association with commercial and local interests, and in fact a number of interesting possibilities are being examined.

FINANCIAL RESULTS

I am not, here, going to try to give you a detailed financial account with a lot of figures. For those who are sufficiently interested the accounts are published every year in the Annual Report. We in the Corporation are very conscious that we are using public money and that through Parliament we have a responsibility to the British taxpayer.

The Corporation was never expected, and never intended to be, an organization for making large profits. Nevertheless, it is expected in due time to pay its way. The requirement in the Overseas Resources Development Act is that the Corporation must manage its affairs so as to secure that its revenues are sufficient to meet all charges to its revenue account, 'taking one year with another'. This means that over a reasonable period the Corporation must earn sufficient to meet all its charges including repayment of capital and payment of interest. Moreover, it is inseparable from good management practice that reserves are accumulated.

Now let us see what has happened so far. In the early years of the Corporation, when it was under a strong popular urge to show vigorous and even spectacular activity in colonial development, some large-scale schemes were started which failed to stand the test of economic and commercial soundness. Consequently, the money expended on them was lost and as the repayment of this money, as well as interest on it, would eventually become due a heavy financial burden was created. The Government recognized the Corporation's difficulty and tried to meet it. They agreed to waive the interest due on abandoned projects which had been started before 1951. They also offered to write off the dead capital on some of these early failures, but when this offer came to be discussed in detail it emerged that the amount to be written off was only about half that which the Corporation considered should come within the offer. We feared that public and Parliamentary opinion would gain the impression that there had been a wiping clean of the slate, whereas a heavy burden of several million of dead capital would have still remained. The Corporation therefore declined the offer and instead transferred the amount to a special losses account. You will find it shown as a separate item in our balance sheet for 1954 where it is shown provisionally as something over £6¼ million; the balance sheet for 1955 has not yet been published.

From the Corporation's start in 1948 until 1955 there has in fact been a deficit every year, but as a result of ruthless pruning of hopeless projects and by careful retrenchment and reorganization of some others the annual deficit has been greatly reduced in recent years until, in 1955, the Corporation is able for the first time to show a surplus on the year's operations. Financially, the Corporation has now turned the corner and, with careful and realistic management, its

financial position should show an increasing improvement in the years ahead. This must also be remembered: the Corporation has been acquiring and developing some useful assets which will in time show a favourable return in the profit and loss account as well as contributing to the economies of the colonies in which they have been established.

I am convinced that any Corporation engaged in colonial development, or any other form of enterprise, is a much more useful instrument if it makes profits than is one which fails to maintain its capital intact and to serve that capital with interest or dividends.

LESSONS LEARNED

I promised to say something of the lessons we have learned and this I will now try to do. I do not deny that the Corporation has had its failures, but we are recovering from them and they have taught many useful lessons both for us and for others. The Corporation was set up with no guiding precedents in a period of acute post-war human and material shortages; it had to create a new machine for a task which, in extent and variety, was entirely new.

There is in the world to-day a widespread urge and a vital need to develop the under-developed areas of the world; energetic action is called for; all kinds of international organizations and local development corporations have been set up, all making demands on available resources of capital and manpower. But one thing is clear, there can be no short cuts to development, particularly in tropical countries. If projects are to be economically sound and worthwhile, there must be a cautious and realistic approach. In this respect the commercial discipline under which the Corporation works is salutary. Proposals for immediate large-scale development must be looked at with much scepticism. There must often be several years of patient experimentation and trial before it can be known that a given crop or a mineral can be produced on a worthwhile scale. All this means delay and is expensive; therefore there must be some certainty that the ultimate return will be such as to justify the cost of experiment and development; there must be a detailed research into markets and the closest possible forecast of prices.

Particularly in tropical agriculture, which is the basis of many colonies' economies, too little is known about the soil, about plant and animal diseases and about the vagaries of climate and rainfall for large schemes to be launched successfully in a hurry. A great deal more has yet to be learned about the economics of mechanized agriculture in the tropics. Land settlement schemes often look attractive socially and politically, but unless there can be introduced an element of non-returnable finance such as C.D. & W. grants, such schemes will generally be outside the Corporation's field.

Another outstanding factor in colonial development that I would emphasize is the vital need for honest and competent management on the spot. There are not enough qualified and competent men of the right calibre for all the jobs that want doing. Wherever appropriate, the Corporation seeks to bring in an established private enterprise which already has a tried organization and an experienced

staff to act as managers, but even this is not universally successful or always necessary. The long-term alternative is for the Corporation to build up a trained staff, but again this cannot be done in a hurry. There are several quite large projects for which C.D.C. has succeeded in obtaining excellent managerial staff who are doing a good job often in difficult circumstances, and with promising results.

There has been some criticism of the Corporation's policy of lending money to other people to carry out development projects instead of doing the development itself. The making of loans has no special priority in Corporation policy but the purposes for which loans have been made, mainly the provision of power, communications, housing, and so on, are all of great value to the colonies concerned, because they provide funds for basic development which will prepare the ground for subsequent much needed secondary development. An assured income from loans which will cover its overhead charges also gives the Corporation greater freedom of manœuvre in taking risks elsewhere; it enables marginal schemes to be given a longer time to prove themselves beyond what would otherwise be justified.

THE FUTURE

Some projects launched three, four or five years ago are now reaching the stage of development at which decisions have to be taken as to the further stages that must follow, so that the early development work can yield fruit. For example, the utilization of the timber from the great afforestation scheme in Swaziland, the processing of bark from the Tanganyika wattle plantations, the further development of the Nyika Forestry Scheme and a number of mineral developments are all being carefully planned, in many cases in co-operation with already arranged commercial associates and with governments, so that they can eventually make their full contribution to increasing colonial primary products. They will, of course, need further outlay of large amounts of capital, not all of which will necessarily be supplied by the Corporation.

The orderly progression of such schemes from stage to stage is just as important a part of the Corporation's duties as the starting of new schemes. Even if no new schemes are started the Corporation has enough development work in prospect to keep it busy for a long time. Nevertheless, many new proposals are continually undergoing careful examination.

Although the Corporation has now been established for eight years, as it looks at the task ahead it feels that it has only just begun. There are some eighty million people in the British colonies, protectorates and dependent territories, all in various stages of political, social and economic development. Speaking as Colonial Secretary in 1951, Lord Chandos said:

> First, we all aim at helping the colonial territories to attain self-government within the British Commonwealth. To that end we are seeking as rapidly as possible to build up in each territory the institutions which its circumstances require. Second, we are all determined to pursue the economic and social development of the colonial territories so that it keeps pace with their political development.

This is a great and exciting task; we in the C.D.C. are proud to be taking some part in it.

DISCUSSION

MR. J. P. MCDONAGH: If I heard right, of the total capital employed six times as much has been spent on power schemes as on communication schemes. Would I be right in assuming that because of the tendency for the latter to give only long-term returns the policy has been to devote a comparatively small proportion of capital to communication schemes? Coupled with that, now that the Corporation is coming out of the red, can one assume that a higher proportion will be advanced to communication schemes in the future?

THE LECTURER: Your figures are right, power is 26·3 per cent and transport 4·5 per cent, so that the relationship is about six to one, but that is not a reflection of any deliberate policy. It has worked out that way. The Corporation is willing to finance a transportation or communications scheme if it comes within the scope of the Corporation.

One of the obvious questions which can flow from this is, if the C.D.C. has spent £400,000 uncovering coal in Southern Tanganyika why does it not finance the construction of a railway from the coast to that coal. The answer is that unless the construction of such a railway can be made a viable proposition it does not come within the mandate under which we work.

Power schemes, on the other hand, in all ordinary circumstances would be self-supporting and able to raise capital on the market, but the position in Malaya for the last few years has been so disturbed that it was not practical to do so in that case.

MR. K. C. SINCLAIR, O.B.E.: I take it from the figures that Mr. Hume quoted that, from the proportion of capital employed to that available, there is no need of more capital. I wonder though if he would comment on the collaboration between his organization and the World Bank, particularly on the practical level?

THE LECTURER: I do not subscribe to the view that no more capital is needed by the C.D.C. The end of our £100 million is in sight.

Collaboration with the World Bank is quite a feature of our work. There are a number of schemes which are under active discussion with that organization, notably the great Kariba Gorge Scheme in the Central African Federation. We are most willing participants with other organizations which have capital funds at their disposal, but alongside their money we also seek managerial skill in employing it.

MR. PERCY ARNOLD: From what I saw and heard in the West Indies, it would appear that the future of the Corporation is no longer to manage, but to finance. In the light of experience, where the Corporation had fallen down in the past, I was told, was in management. The Corporation could best help by joining with existing firms in the territories, and therefore taking to financing projects jointly with other people rather than managing them themselves. Is this a future trend of the Corporation?

THE LECTURER: You have asked a most important question and I will answer it by quoting a typical case. The Corporation has a large fund of money placed at its disposal by the taxpayers of this country. Somebody comes to it and suggests that it would be a very good thing to grow wattle in Tanganyika and to construct a factory in which the wattle bark is processed and becomes tanning extract. When it is made, it has to be sold, and the whole enterprise conducted efficiently and profitably. It is not practicable for the Corporation to have within itself at any given time a man to whom it can be said 'Mr. Jones, put on your tropical suit and go off to Southern

Tanganyika and grow a wattle forest and make the bark into extract and then sell it'. The C.D.C. must necessarily find some body or bodies capable of doing that. In the period of full employment which we have enjoyed since the war, it is no good putting an advertisement in the press to say 'Wanted: wattle-forest grower'. You will not get one, except perhaps one who is no good. That was one of the ideas which was tried at the start of this Corporation with disastrous results. So you have necessarily to go to some experienced organization and say 'we have the money, you have the managerial experience; now that is a good partnership, let us work together'. The successful managerial structure does not grow over night. It cannot be hired by advertising in the press for it. Somebody must be approached who through years of trial and error has built up a business which works efficiently and profitably. I most sincerely believe that, unless an organization is profitable, it is no good to anybody—financier, employees, government, or local people.

Another example of what I mean is that when Unilever came in with us in Nairobi, the whole project got right because they brought their experience to bear on it. I hope that explains why we are swinging away from trying to run projects ourselves.

SIR EDMUND TEALE: I would like to ask Mr. Hume a question with reference to Tanganyika. He has referred to two schemes which have been investigated, the coal in the south-west and the wattle plantation which is being developed. He indicated that it is outside the scope of the Corporation to consider contributing to the cost of railway construction to develop the coalfields. Some little time ago Sir Edward Twining indicated, with regard to the opening up of the south-western area, that there were three milestones which would eventually determine the building of the railway so vital for the development of that region. The third milestone was the utilization of the Kilombero Valley which offered considerable promise. Has the Kilombero project come within the scope of the Corporation's investigations?

THE LECTURER: We are discussing the scheme which will lead to the building of the railway and hope that something will come of it; but there again we have got the question of arranging for commercial partners. However, when I was in Tanganyika recently the decision to build that railway was fairly well advanced.

MR. ANTHONY HURD, M.P.: Would Mr. Hume tell us when the light dawned to the C.D.C. that they must work closely and intimately with the people on the spot, who would have the know-how which he has just referred to as being essential? I have a first-hand knowledge of the Falkland Islands. That little Colony has bitter disappointment through the hopes that were raised by the development of a freezer works at Ajax Bay, and also a sealing station at Albermarle. The freezer only worked for two years and now it is being written off and abandoned. The same has happened to the sealing enterprise.

It seems to me that both those projects stood a chance of success if the C.D.C. had not been quite so rash, but had begun with a modest pilot scheme and taken the advice of local people—these projects might be working satisfactorily to-day. What is much more important, they might have been earning income which would be very useful to the Colony and to the Empire. I do very much hope that the lecturer will be able to reassure us now that the light has dawned and that we do not ever go into projects of that kind without the fullest consultation at the start to get the co-operation of the local people.

I feel a little bitter about this because the C.D.C. now say that the freezer failed because local interests, notably the Falkland Islands Co., of which I am a director, had not given enough support. I took the trouble to get out the figures whilst I was there and I found that in 1954, which was the last year in which the freezer operated, 16,000 sheep had been sent through the freezer of which the Falkland Islands Co., owning forty per cent of the sheep in the islands, sent 9,000—a very fair forty per

cent! It seems that the blame has been put on local people for the failure of projects when really the C.D.C. were too rash, too impetuous at the start, and did not take the advice about the prospective supplies of sheep and cattle and the scope of the project which would have been freely available to them.

THE LECTURER: I do not want to introduce a controversial note, but there are other people who hold a different opinion. Admittedly that scheme was started in a rather too light-hearted way, but none the less once the freezer was put up it was there and I believe it was reasonably technically efficient. We offered to let it to the local people for a peppercorn and they turned the offer down. I do not know what else we could have done. We might have tried once more advertising in the daily press saying, 'Manager wanted for freezer in the Falkland Islands', but when the local people say 'thanks, we are not having it for nothing', I do not know really where one goes.

SIR ROBERT STANLEY, K.B.E., C.M.G.: The speaker referred, when speaking of the regions, to the possibility of development in the western Pacific. Could he say whether the Corporation contemplate any activity in that direction and whether he feels that in that case it would be possible to give satisfactory supervision from headquarters, say, in Singapore?

THE LECTURER: The C.D.C. itself would be unlikely to initiate a scheme in the western Pacific islands. If, however, the local government or somebody who was interested in that area invited us to participate financially with them, the scheme would be judged on its merits like any other. The question of supervision is one with which I tried to deal in answer to another question. I do not think we could supervise from London a scheme in the western Pacific islands if it had not got the right managerial association in the way I have already tried to describe. This region is not excluded for any geographical reason and, if a scheme comes from those parts of the world, we should in fact be glad to hear about it.

SIR SELWYN SELWYN-CLARKE, K.B.E., C.M.G., M.C. (Chairman, Commonwealth Section Committee): I am sure we are all grateful to Mr. Nutcombe Hume for his very particularly lucid exposition of the work and organization of the C.D.C. It is easy to understand the justifiable pride of those working with the Corporation in the success that has attended their efforts to help the Commonwealth territories in their socio-economic development *pari passu* with the political progress. One sometimes hears criticism of the failure on the part of the Corporation to work in closer partnership with the Colonial Development and Welfare Fund. The instance that was mentioned in relation to the coal-field in Tanganyika would seem to me one in point where it would be quite right and proper for the Corporation to develop the area and to do the research work, find the coal, and so forth, and indicate how it could be developed commercially, and perhaps for the Colonial Development and Welfare Fund to construct the railway which would make it possible to exploit this coal. The reorganization of the Corporation on a regional basis in 1951 which Mr. Hume told us resulted in the improvement of local relations, apart from effecting a very considerable reduction in the administrative costs, I think answers another criticism which is sometimes levelled against the Corporation and which has been referred to by one of the previous speakers; that is to say, the insufficient consultation with local interests which took place in former days.

Mr. Hume mentioned racial discrimination and, personally, I should never associate the Corporation with any such idea, but it makes good hearing to know that it is a deliberate policy of the Corporation not to allow any such discrimination.

With so much that is admirable, I trust it will not be taken amiss if I mention just one matter. I hope that the Corporation will exercise its discretion in conforming to

local conditions, wages, housing, and so on. I would like to give an instance in point. When I went to Hong Kong in 1938 women were cleaning ginger for ten hours a day at the 'colossal' wage of 1½*d.* per day. In the last colony in which I served labourers received an equally gargantuan wage when I first set foot in the islands. If they were women they were paid 12*s.*, if men 24*s.*; not per week, but per month! I should hate to feel the Corporation would be a party to the payment of employees at such rates.

It is very heartening to hear that the Corporation is paying particular attention to the development of medical and welfare services, especially housing.

Does Mr. Hume think that there is a case for better co-ordination, or better integration, between the Colonial Development and Welfare Fund and his Corporation ?

THE LECTURER: Thank you for what you said. Yes, we are pressing all the time to have a closer working arrangement between the C.D.C. and the Colonial Development and Welfare Fund. We hope it will come about. But this Colonial Development and Welfare Fund money is regionalized and the contact might have to be made in the regions. I would hesitate to agree with you that the Colonial Development and Welfare Funds should necessarily be used to finance the construction of a railway. I think that unless a railway holds out the prospect of becoming self-supporting, it would not perhaps be right to use the British taxpayers' money for its construction.

SIR GILBERT RENNIE, G.B.E., K.C.M.G., M.C. (High Commissioner for the Federation of Rhodesia and Nyasaland): May I express appreciation of the good work which the C.D.C. has done in the territory with which I was very closely concerned, Northern Rhodesia, and is still doing in the territories with which I am connected at present, namely, the Federation of Rhodesia and Nyasaland. The Corporation has done most valuable work in developing some very important projects in the three territories and I am sure that the Federal Government and the three territorial Governments very much appreciate the co-operation of the Corporation and the very valuable services rendered to the development of their territories by it.

THE CHAIRMAN: It only remains for me to express what I am sure is your feeling—our great gratitude to Mr. Nutcombe Hume for the lucid and extremely able way in which he has explained to us the working of the Corporation and its organization for the work which it has to do, and also for the very convincing way in which he has answered the questions which have been fired at him. He has shown that the Corporation is not free under its Charter to do anything anyway it likes, and there are very severe limitations on its work, and that there will be almost unlimited possibilities for the employment of new capital in the future, after all £100 million is a very small sum when related to the field over which it has to be spread. Last, but not least, I should like to thank you, on behalf of myself and your audience, Mr. Hume, for having shown that the Corporation is under sane management.

A vote of thanks to the Lecturer was carried with acclamation; and, another having been accorded to the Chairman, the meeting then ended.

OBITUARY

MR. ROBERT Y. EATON

We record with regret the death, on 28th July, 1956, of Robert Young Eaton, formerly President of the T. Eaton Co., Ltd., in Toronto.

Robert Y. Eaton was born at County Antrim, Ireland, in 1875, and was educated at the University of London. He joined the T. Eaton Co. as a shipping clerk at the

company's London office in 1897. Later, he moved to the Paris office and, in 1902, went to Canada where he was appointed Secretary of the Company in Toronto.

In 1904, Mr. Eaton was appointed First Vice-President. Eighteen years later, following the death of Sir John Eaton, he was appointed President of the Company, and remained in that capacity until his retirement in 1942.

Widely known as a patron of the arts, he served as President of the Art Gallery of Toronto from 1924 to 1941, following which he was appointed Honorary Vice-President. Mr. Eaton was also a Director of the National Trust Co. and of the Dominion Bank, Honorary Vice-President of the Canadian Red Cross Society, 1941–47, Honorary Director of the Canadian National Exhibition, Governor of the Drama Festival, and a Member of the Board of Governors of the Royal Conservatory of Music, Toronto.

During World War II, he served the Canadian Government as a Member of the National War Loan Committee, among other projects. He held the rank of Honorary Colonel in the reserve army and was connected with both the Governor-General's Horse Guards and the Third Armoured Regiment as Honorary Lieutenant-Colonel.

Mr. Eaton was elected a Life Fellow of the Society in 1929, and was a sponsor of the Canadian Banquet held in honour of the Society's Bicentenary.

FROM THE JOURNAL OF 1856

VOLUME IV. *29th August*, 1856

From a letter by Mr. C. H. Bromby of Cheltenham

EXAMINATION

Sir,—No act of the Society of Arts is more likely to tell upon the education of the artisan than the resultion which has been so vigorously adopted and carried out during the last few weeks. In the absence of any public system of secondary education, such as the continental governments have instituted, there has been hitherto no encouragement to the boy who has left the elementary school, to carry forward or to preserve the little knowledge that he possesses. I cannot, however, but lament that the advantage to be held out should be restricted to members of Mechanics' Institutes. If the Society would affiliate elementary schools, or, at least, *commercial* and *trade* schools, a great inducement would at once be held out to parents to keep their children longer at school, and a corresponding impulse would be given to *night schools*, in which boys removed to work might still prosecute their studies Night Schools, as a whole, I take it are a failure. To serve a substancial purpose they should supply the want of *Ecoles de Dessin* and other institutions of secondary education in France and other countries, for want of which our own country will soon be left behind in the markets of the World. The Society of Arts has taken the initiative in supplying that radical defect, but her leverage will be immensely increased if she would extend her patronage to all schools which profess to instruct the pupils in those principles of science that enter into the everyday of our operatives

I have under my care an elementary school and a higher school. Promising boys may be promoted from the lower to the higher without additional payment. All I want is the opportunity of sending up the best pupils to the examinations of the Society of Arts, and so of rendering them eligible to situations of trust, in order to open out the most encouraging prospect of promotion to a boy of real talent, though he belongs to the lowest condition of life.

By an extension of privilege, such as I have proposed, it appears to me that a great stimulus would be applied to popular education, while the chartered object of the Society of Arts would be directly promoted—the progress of Arts, manufactures and commerce throughout the land.

*THE SOCIETY'S CHRISTMAS CARD, 1956

The subject of the card, painted in full colour by Miss Anna Zinkeisen R O I R D I is a meeting of the Society of Arts in 1759 at which Benjamin Franklin is shown helping to interview candidates for prizes in the Society s art competit on

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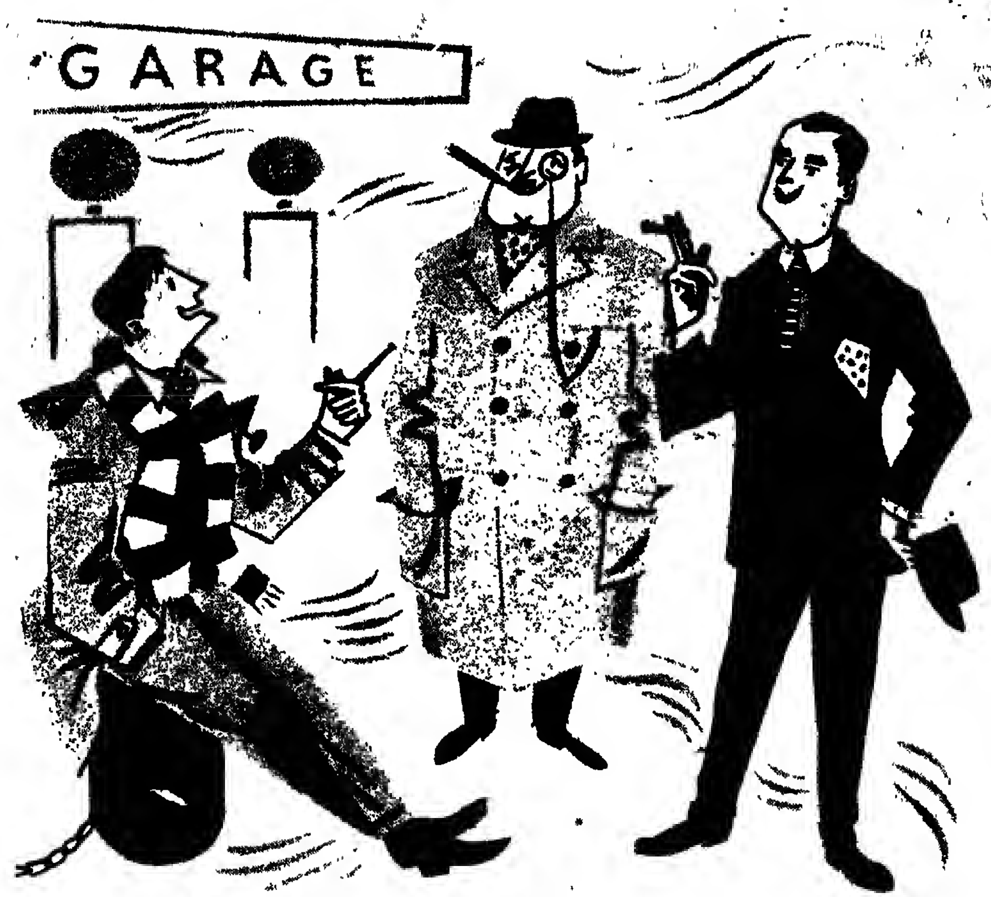

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